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NUCLEAR SCIENCE ABSTRACTS

Volume 16 Number 11

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June 15, 1962

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Volume 16, Number 11 June 15, 1962

NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

12800 (BRL-1153) UNDERWATER EXPANSION OF A BLAST LOADED THIN SPHERICAL SHELL. R. C. Makino and J. Giese (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Oct. 1961. 37p.

The reaction of a thin spherical shell surrounded by water and containing a runaway reactor is studied by analysis of the linear equations of motion of water and of the equation of motion of a shell moving under blast loading. To avoid the slow convergence encountered in Fourier series representations of the motion, the general form of the solution is exploited to reformulate the problem in terms of an ordinary differential equation. This can be integrated numerically easily and rapidly. A version of the reformulated problem in which the shell motion is also linearized is solved analytically and investigated in detail. (auth)

12801 (IA-685) RESEARCH LABORATORIES SEMI-ANNUAL REPORT FOR THE PERIOD JANUARY–JUNE 1961. (Israel. Atomic Energy Commission, Tel Aviv). 100p.

Progress is reported on research conducted on reactor physics, nuclear physics, metallurgy, chemistry, geology, biology and medicine, electronics, and documentation. Work done at the IRR-1 reactor is summarized in terms of operation, calibrations, high-precision charge integrator developments, training, and isotope production. (B.O.G.)

12802 (NP-11558) MODEL STUDIES OF BLAST EFFECTS. IX. PRESSURE RISE IN CHAMBERS DUE TO SHOCK WAVE FILLING THROUGH AN ORIFICE. Suffield Technical Paper No. 236. J. C. Muirhead (Canada. Suffield Experimental Station, Ralston, Alberta). Jan. 9, 1962. 15p.

A theory for predicting the pressure rise in chambers resulting from the entry of blast waves through orifices, was evaluated experimentally. The results showed that this theory predicts the maximum average pressure in the chamber to within ±20%, except where the pressure in the chamber exceeds the incident pressure. (auth)

12803 (PNE-109P) EARTH DEFORMATION FROM A NUCLEAR DETONATION IN SALT. R. B. Hoy and R. M. Foose (Stanford Research Inst., Menlo Park, Calif.). Jan. 22, 1962. Contract [AT(04-3)-115]. 46p. Project GNOME.

Measurement of rock deformation caused by the Gnome explosion revealed that maximum permanent surface displacement was confined to an area within 100 meters of surface ground zero. The surface above ground zero remained permanently raised 0.3 to 0.5 meters after an initial transient displacement estimated to be 1.5 meters. The permanent deformation was characterized by fractures with offsets up to 0.2 meters. Abundant hair-line fractures were observed out to 300 meters. Occasional small fractures were noted as far as 1000 meters from surface ground zero. Underground, fractures were observed in the shaft lining at 23, 27, 49, and 146 meters, with a slight water seep at 146 meters. The tunnel examination, which prior to January 10 was limited to the station near the bottom of the shaft, revealed an irregularly cone-shaped pile of slabs reaching a maximum height of 1.2 meters at the center of the room. Four large slabs had fallen from the walls and fine spalling had removed most of a reference grid which was painted on the wall. Indications are that a stable cavity 40 meters high was formed which could be used for underground storage or to assist in mineral extraction. (auth)

12804 (PNE-110P) SEISMIC WAVES FROM AN UNDERGROUND EXPLOSION IN A SALT BED. D. S. Carder, W. V. Mickey, L. M. Murphy, W. K. Cloud, J. N. Jordan, and D. W. Gordan (Coast and Geodetic Survey, Washington, D. C.). Feb. 1962. Contract AT(29-2)-746. Project GNOME. 89p.

Seismic waves resulting from a 5 kt nuclear detonation 1200 feet deep in a salt bed near Carlsbad, New Mexico, were measured by strong-motion seismographs operated by the Coast and Geodetic Survey on the surface in the distance range from 0.5 to 8.8 miles and underground in a potash mine 8.7 to 11.2 miles distant. In addition, many temporary and permanent seismographs were operated on a continent-wide and world-wide basis. Ground particle accelerations exceeded those for the Logan shot, a like detonation in tuff, by a factor of about 4, and accelerations underground in the salt bed were about half those on the nearby surface. There was no evidence of damaging accelerations in nearby commercial operations or dwellings. Nearby transient ground particle displacements were about the same as those for the Logan shot, except the frequencies were higher. Attenuation with distance across the plains to the east was relatively low as compared with similar effects in the mountain and plateau area toward the west. Upper mantle travel times likewise were higher toward the east, 8.3 to 8.4 km/sec, as compared with 7.8 to 8.1 km/sec toward the north, west, and northwest. The estimated magnitude of the Gnome shot was from 4.6 to 5.0, depending on the choice of data. (auth)

12805 (WT-2) JAPTAN ISLAND DEVELOPMENT AND ANIMAL PRODUCTION. Annex 2.1 [of] SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. Part I. FACILITIES. George V. Leroy. Part II. ANIMAL COLONY. R. J. Veenstra (Army Veterinary Corps). Operation GREENHOUSE. 43p.

Since rats, goats, and pigs used in the Bikini test showed almost as much change in behavior and blood picture due to environmental changes as from the actual test itself, it was decided to establish colonies of mice, dogs, and swine on Japtan Island in preparation for Operation Greenhouse. The animal quarters, special handling equipment, laboratory, shop, and living quarters for personnel are described. Procedures which were used in breeding, cleaning and sterilizing of equipment, record keeping, marking of animals, feeding, veterinary care, and shipping are given. A history of the entire program is included. (auth)

12806 (WT-60(REF)Pt.I) U. S. ARMY STRUCTURES. APPENDIX 2. AS-BUILT CONSTRUCTION. ANNEX 3.1 [OF] SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. (Ammann and Whitney, New York). Nov. 1951. Operation GREENHOUSE. 168p.

Construction drawings and specifications for Greenhouse Operation test structures, along with major as-built deviations from these specifications, are listed. (T.F.H.)

12807 (WT-60(REF)Pt.II) U. S. ARMY STRUCTURES. APPENDIX 2. AS-BUILT CONSTRUCTION. ANNEX 3.1 [OF] SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. (Ammann and Whitney, New York). Nov. 1951. Operation GREENHOUSE. 115p.

12808 (WT-60(REF)Pt.III) U. S. ARMY STRUCTURES. APPENDIX 2. AS-BUILT CONSTRUCTION. ANNEX 3.1 [OF] SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. (Ammann and Whitney, New York). Nov. 1951. Operation GREENHOUSE. 143p.

12809 (WT-91) U. S. NAVY STRUCTURES. ANNEX 3.2 [OF] SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. Charles L. Hayen (Bureau of Yards and Docks). June 1952. Operation GREENHOUSE. 303p.

Structures are subjected to a 50-kt blast, in order to obtain fundamental data on structures subjected to blast loading, to observe the response of the structures under this loading, and to determine the relative blast-resistance merits of several structural types. Modes of failure are determined. Shaped structures are found to be superior to rectangular structures. Earth cover for the structures is also found to increase the blast resistance. It is found that standard Navy heavy bomb-proof structures with modifications can withstand a near-surface atomic burst at ground zero. (T.F.H.)

12810 (WT-772) EFFECTS OF THERMAL RADIATION ON MATERIALS. Thomas I. Monahan and Willard L. Derksen (Naval Material Lab., Brooklyn). May 1954. Project 8.9 of Operation UPSHOT-KNOTHOLE. 51p.

A physical skin simulant was evaluated for determining the burn severity behind irradiated cloth barriers. The skin simulant consists of a polyethylene plastic, in the surface of which a thermocouple is imbedded to measure the associated temperature rise. The purpose of the project was to correlate exposures to the nuclear detonation with the corresponding exposures to laboratory sources of thermal radiation. Supporting measurements were made, including the spectral distribution of and the equivalent black-body temperature of the radiation incident at the several stations, employing passive-receiver calorimeters; evaluation of temperature-sensitive indicators for use with the physical skin simulant; the effect of duration of exposure on the extent of thermal damage; and the contribution of a material's absorptance and other material parameters to the total thermal damage to cloths. Data are tabulated. (auth)

12811 (WT-776) SOUND VELOCITIES NEAR THE GROUND IN THE VICINITY OF AN ATOMIC EXPLOSION. R. C. McLoughlin and F. C. Foushée (Navy Electronics Lab., San Diego, Calif.). Jan. 1955. Project 8.12a of Operation UPSHOT-KNOTHOLE. 63p.

Sound velocities in the air close to the ground near the nuclear detonations of Shots 9 and 10 were measured by determining the transit time of acoustic signals across air paths of known lengths. The regular velocity meters were oriented in such a way as to measure the sum total of wind velocity along the blast line and acoustic velocity due to temperature. A device called a particle velocity meter was used to measure both preshock and postshock wind velocities, separating them into their components in three mutually perpendicular directions and giving the velocities due to temperature alone as well. Measurements were made at elevations of 3.5 and 10 ft over various types of terrain, namely desert soil, fir boughs, black iron, and sand covered with emulsified asphalt at intended ground zero. The results of these tests are summarized. (C.H.)

12812 (WT-781) EXPERIMENTAL SOIL STABILIZATION. W. G. Shockley and W. J. Turnbull (Waterways Experiment Station, Vicksburg, Miss.). Feb. 1954. Project 9.7 of Operation UPSHOT-KNOTHOLE. 38p.

This project was designed to evaluate the performance of several soil-stabilizing materials under atomic detonation in order that their effectiveness in minimizing smoke and dust, which heretofore have obscured motion picture photography, might be determined. The stabilizing materials tested were sand-cement, sodium silicate, and lignin. Evaluations were based on observations of test panels of the materials plus the general behavior of sand-cement production stabilization. The study shows that sand-cement is satisfactory as a primary stabilizing material provided certain construction considerations are followed. Both sodium silicate and lignin were demonstrated to be satisfactory secondary stabilizing materials. (auth)

12813 (WT-1101) MEASUREMENT OF FREE AIR ATOMIC BLAST PRESSURES. N. A. Haskell, James A. Fava, and Richard M. Brubaker (Air Force Cambridge Research Center. Terrestrial Sciences Lab., Mass.). Feb. 14, 1958. Project 1.1 of Operation TEAPOT. 47p.

Peak free-air overpressure versus time measurements in the 10-to-2 psi range were obtained as a function of distance directly over a nuclear burst at a low scaled height. This information was to be used to establish the points in space at which the reflected and direct shock waves merge into a single shock wave and to determine the overpressure as a function of distance for the merged wave, in support of drone-aircraft lethal-volume studies. It was also desired to obtain free air peak overpressure versus distance measurements for an atomic burst at a high altitude. Data are tabulated that were obtained by deploying, from a B-29 aircraft, 10 parachute-borne instrumented canisters on each shot. The second objective was achieved by deploying 15 parachute-borne canisters from the strike aircraft on one shot. (C.H.)

12814 (WT-1117) NEUTRON-INDUCED RADIOACTIVE ISOTOPES IN SOILS. R. F. Johnson, C. S. Cook, L. A. Webb, and R. L. Mather (Naval Radiological Defense Lab., San Francisco). Aug. 7, 1958. Project 2.3a of Operation TEAPOT. 52p.

An investigation was made of the activities induced in the

surface of the earth near ground zero by nuclear-explosion released neutrons. Gamma radiation from test site soil obtained from ground zero following air bursts, tower shots, and underground explosions were studied. It is concluded that the quantities of neutron-induced activity to fission-fallout activity are functions of height, yield, and type of detonation. Na^{24} and Mn^{56} activities found in blast-exposed soils were activated in proportion to the amount of Na and Mn atoms present at irradiation time. (J.R.D.)

12815 (WT-1127) AIR BLAST EFFECTS ON UNDERGROUND STRUCTURES. R. E. Woodring, G. K. Sinnamon, and N. M. Newmark (Illinois. Univ., Urbana and Office of the Chief of Engineers. Protective Construction Branch, Washington, D. C.). Aug. 20, 1957. Project 3.4 [of] Operation TEAPOT. 78p.

A study was made of the behavior of buried shelters subjected to the blast from air bursts of large scale nuclear devices. The investigation included the nature of the forces transmitted from an air burst of an atomic device through the earth to underground structures; the variation of these forces with the depth of the structure in the earth and with the flexibility of the structural elements; and the response of simple structural elements of different stiffnesses and effective masses subjected to the transmitted dynamic forces. (C.H.)

12816 (WT-1128) EVALUATION OF EARTH COVER AS PROTECTION TO ABOVEGROUND STRUCTURES. R. B. Vaile and L. D. Mills (Bureau of Yards and Docks). Dec. 1956. Project 3.6 [of] Operation TEAPOT. 64p.

An evaluation was made of the protection afforded by an earth cover to aboveground shelters. The adequacy of an adaptation of a corrugated steel-arch ammunition magazine as a personnel shelter was studied. Data were obtained on both the blast resistance and the radiation resistance of such structures both with and without earth covers. In addition to two full-scale structures, six models were used. Evaluation of results led to the conclusions that static model tests prior to any further full-scale blast tests will enhance the value of the results and will reduce the cost of full-scale operations. (C.H.)

12817 (WT-1419) INITIAL NEUTRON AND GAMMA AIR-EARTH INTERFACE MEASUREMENTS. E. N. York, R. E. Boyd, and J. A. Blaylock (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Feb. 23, 1960. Project 2.10 of Operation PLUMBBOB. 66p.

Supersedes ITR-1419.

Measurements of total gamma dose, gamma dose rate, neutron flux, and neutron dose were made at the surface and at heights up to 950 ft to determine the effect of the air-ground interface on initial nuclear radiation. It was found that total gamma dose increased with height to a value, at 400 ft, 30% greater than ground measurements. There was no further increase up to 950 ft. The effect was the same at all stations from 1500 to 3500 yards horizontal distance from burst point. There was no change in the ratio of gamma dose rates at the balloon stations compared to dose rates at ground stations over the first 5-second interval for which records were obtained. Sulfur neutron-flux measurements increased with height to a value of 30% greater than gound measurements at 500 ft. No change was observed from 500 to 950 ft. Neutron repdose measurements were not conclusive. (C.H.)

12818 (WT-1420) BLAST LOADING AND RESPONSE OF UNDERGROUND CONCRETE-ARCH PROTECTIVE STRUCTURES. W. J. Flathau, R. A. Breckenridge, and C. K. Wiehle (Waterways Experiment Station, Vicksburg, Miss. and Naval Civil Engineering Lab., Port Hueneme, Calif.). June 5, 1959. Project 3.1 of Operation PLUMBBOB. 139p.

Supersedes ITR-1420.

Four reinforced-concrete arch structures, with the top of arch crown 4 ft below ground surface, were exposed at high overpressure ranges from Priscilla Burst in order to obtain data on their resistance to blast, radiation, and missile hazards. The four structures received actual air overpressures of 56, 124, and 199 psi and suffered only minor damage, all remaining structurally serviceable. The entranceway used for the structures sealed out the air pressure. It was not designed to attenuate radiation and thus did not provide adequate radiation protection for personnel. There were no missile and apparently no dust hazards in any of the structures. Results of the test indicate that an underground reinforced-concrete arch is an excellent structural shape for resisting the effects of a kiloton-range air burst. (C.H.)

12819 (WT-1423) BLAST EFFECTS ON EXISTING UPSHOT-KNOTHOLE AND TEAPOT STRUCTURES. E. H. Bultmann, Eugene Sevin, and T. H. Schiffman (Illinois Inst. of Tech., Chicago. Armour Research Foundation and Air Force Special Weapons Center, Kirtland AFB, N. Mex.). May 6, 1960. Project 3.4 of Operation PLUMBBOB. 128p.

Supersedes ITR-1423.

Structures remaining from Operation Upshot-Knothole and Teapot were retested during Plumbbob in order to secure blast loading and response data. Single-story, steel-framed, industrial buildings, reinforced-concrete panels and a cubical concrete block in the interior of a partially open structure, underground beams, underground test chambers, reinforced-concrete roof slabs, a wall panel of corrugated-asbestos siding, and a cinder block wall panel were tested. Data from each of these tests are presented and pretest and posttest photographs are included. (C.H.)

12820 (UCRL-Trans-790(L)) THE PEACEFUL APPLICATION OF NUCLEAR BOMBS. Theodore Ginsburg. Translated by Sergey Shewchuck (Univ. of California. Lawrence Radiation Lab., Berkeley) from Neue Zurcher Ztg., No. 152, 9011-55(Nov. 2, 1960). 44p.

The utilization of nuclear energy produced explosively and stored as heat for later withdrawal is considered. General aspects of underground nuclear explosions are clarified and the possibilities of obtaining electrical energy from bombs is analyzed. (J.R.D.)

12821 EFFECTS OF NUCLEAR EXPLOSIONS ON THE IONOSPHERE. Walter Dieminger and Harry Kohl (Max-Planck-Institut für Aeronomie, Lindau/Harz, Ger.). Nature, 193: 963-4(Mar. 10, 1962).

On Oct. 30, 1961, the critical frequency of the F2 layer of the ionosphere over Lindau/Harz increased by 3.7 Mc between 10 hr 00 min and 10 hr 30 min UT, after the Soviet 50-megaton nuclear explosion. Afterwards, the critical frequency dropped in an oscillatory manner, giving four maxima at ~1.5-hr intervals. On Oct. 31, a minor disturbance was noted in the F2 layer. Possible interpretations of the observations are given. An increase of the F2 layer critical frequency was also noted on Oct. 23, 1961, after a small Soviet nuclear explosion. (D.L.C.)

12822 NUCLEAR EXPLOSIONS AND THE GRAVITY-TIME CURVE. S. Balakrishna and P. V. Johnson (Osmania Univ., Hyderabad, India). Nature, 193: 964-5(Mar. 10, 1962).

The effects of the Soviet nuclear tests in 1961 on the gravity-time curve of an Askania gravimeter at Hyderabad are described. The effects of the tests differ from these of earthquakes in that the disturbances are of longer duration and exhibit constant and continued high amplitudes. It is suggested that the gravimeter can be used to detect atmospheric tests. (D.L.C.)

12823 ATOMIC ENERGY RESEARCH. LIFE AND PHYSICAL SCIENCES; REACTOR DEVELOPMENT; WASTE MANAGEMENT, 1961. A Special Report of the United States Atomic Energy Commission, December 1961. (Atomic Energy Commission, Washington, D. C.). 349p. $2.25(GPO).

The report is divided into four sections. A separate abstract was prepared for each section. (J.R.D.)

12824 RESEARCH IN MEDICAL AND LIFE SCIENCES. p.1-140 of "Atomic Energy Research. Life and Physical Sciences; Reactor Development; Waste Management, 1961."

Research is reported in sections on radiation in medicine and agriculture, and summaries are presented on cancer research, somatic effects of radiation, radiation protection and treatment, genetics, molecular and cellular studies, chemical toxicity, instrumentation, studies of environmental radiation, fallout, and atmospheric radioactivity studies. (J.R.D.)

12825 RESEARCH IN PHYSICAL SCIENCES. p.141-205 of "Atomic Energy Research. Life and Physical Sciences; Reactor Development; Waste Management, 1961."

Physical research is reported in chemistry, physics and mathematics, metallurgy and materials, and controlled thermonuclear reactions. (J.R.D.)

12826 REACTOR PROGRAM RESEARCH. p.207-61 of "Atomic Energy Research. Life and Physical Sciences; Reactor Development; Waste Management, 1961."

Research of a fundamental nature is reported which is broadly based and has general application to many reactor systems. Research and development are reported in such areas as reactor safety, processing of spent fuels, reactor physics, and reactor components and associated equipment. (J.R.D.)

12827 WASTE MANAGEMENT STUDIES. p.263-94 of "Atomic Energy Research. Life and Physical Sciences; Reactor Development; Waste Management, 1961."

Programs are described on environmental research, including estuary and marine projects, stream and river work, and earth and soil studies. Developmental studies are also reported on the treatment of radioactive wastes, disposal methods, and related projects. (J.R.D.)

12828 LEGAL AND ADMINISTRATIVE PROBLEMS OF PROTECTION IN THE PEACEFUL USES OF ATOMIC ENERGY. Proceedings of the International Symposium held in Brussels from 5 to 8 September 1960. Brussels, EURATOM, 1961. 1259p.

Papers are presented from the 1960 International Symposium called by the Commissione della Comunitá Europea dell'Energia Atomica (Euratom). Such topics are discussed as basic legislation on radiation protection; workmen's compensation and radiation injuries; the licensing of nuclear installations and materials; and the international control of radioactive contamination of water, air, and soil, and related problems. The papers are presented in the language in which they were presented and in English. (T.F.H.)

12829 TECHNOLOGY, ENGINEERING AND SAFETY. VOLUME 4. C. M. Nicholls, ed. Progress in Nuclear Energy. Series IV. New York, Pergamon Press, 1961. 528p. $20.00.

Sixteen papers are presented which review research and development in the fields of nuclear engineering, reactor technology, materials and processes, and nuclear safety. Contributions are given on the use of helium and graphite in high temperature reactors, plutonium ceramic technology, American developments of gas-solid and liquid-liquid chemical engineering operations involved in uranium processing and in the reprocessing of uranium fuels, the complex criticality considerations involved in the transportation of fissile materials, and the design of safe nuclear installations. Other reviews are also given which are of current interest in the field of nuclear engineering. Separate abstracts have been prepared for 15 papers; one was previously abstracted in NSA. (N.W.R.)

12830 BOILING STABILITY. R. P. Anderson and P. A. Lottes (Argonne National Lab., Ill.). Progr. in Nuclear Energy, Ser. IV, 4: 3-28(1961).

Boiling flow stability problems as applied to natural circulation boiling systems and reactors are discussed. Reactor technology, in its present state, cannot predict either the dependence of the oscillation inception point or the frequency and amplitude of oscillation on operating conditions or design parameters. However, an experimental test program using both reactors and hydrodynamic test loops has shown certain trends in the dependence of oscillation on various parameters and conditions. The experimental program and analytical work associated with reactor and test loop stability are reviewed. (N.W.R.)

12831 NUCLEAR REACTOR HEAT TRANSFER TECHNOLOGY. M. E. Lapides (General Electric Co., Philadelphia). Progr. in Nuclear Energy, Ser. IV, 4: 29-50(1961).

Analytical and experimental data are presented on heat transfer by various classes of fluids (ordinary fluids, liquid metals, heat generating fluids, and boiling liquids) in simple duct geometries. The information is applied in an interpretation of tests of fuel element geometries where additional problems of assessing flow distribution and fluid mixing are encountered. The effects considered include: entrance region, influence of duct length, average and local coefficients, mode of heat input, intensity of heating, surface roughness, and duct cross section. Data for various fuel element geometries are associated with particular fluids where applicable. Major emphasis is on gases, heat generating fluids, and advances in boiling heat transfer. (N.W.R.)

12832 HELIUM AS A REACTOR COOLANT. A. P. Fraas (Oak Ridge National Lab., Tenn.). Progr. in Nuclear Energy, Ser. IV, 4: 53-62(1961).

The combination of high thermal conductivity and specific heat coupled with chemical inertness gives helium unique advantages over any other gas as a reactor coolant. These advantages are particularly pronounced if the reactor is designed to operate at temperatures above 1000°F. Four major reactors are based on helium as the coolant, i.e., Dragon and Winfrith Heath, EGCR at Oak Ridge, HTGR near Philadelphia, and Turret at Los Alamos. In each instance helium was chosen in preference to carbon dioxide in an effort to avoid graphite-carbon dioxide reactions which lead to serious losses of graphite from the core and deposition of carbon in the steam generator or heat exchanger. (N.W.R.)

12833 THE PURIFICATION OF HELIUM IN HIGH TEMPERATURE REACTORS. J. E. Antill, D. Bradley,

R. H. Flowers, and N. Hodge. Progr. in Nuclear Energy, Ser. IV, 4: 63-101(1961).

High temperature gas cooled reactors are being designed to release a proportion of their fission products to the gas coolant (helium). The use of graphite as moderator in these reactors necessitates the control of gaseous impurities to minimize corrosion. Methods of removing both fission products and chemical impurities are reviewed. The purification plant designed for the Dragon reactor is used to illustrate this review. (auth)

12834 GRAPHITE TECHNOLOGY. F. Roberts, J. B. Mason, M. S. T. Price, and J. Bromley (United Kingdom Atomic Energy Authority [Risley, Eng.]). Progr. in Nuclear Energy, Ser. IV, 4: 105-46(1961).

The manufacture and purification of graphite is reviewed, pointing out how the introduction of new techniques is increasing the range of graphites which can be produced. The physical properties are reviewed in detail, and it is shown how this information leads to a knowledge of its structure. Some of the particular graphite problems which have to be solved if advanced types of high-temperature graphite-moderated reactors are to be successfully operated are also discussed. The properties of porous graphite are also reviewed. The bibliography contains 241 references. (N.W.R.)

12835 PLUTONIUM CERAMICS AS NUCLEAR FUELS. L. E. Russell (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Progr. in Nuclear Energy, Ser. IV, 4: 147-65(1961).

Plutonium ceramic fuel development work is reviewed. This is a logical extension of work on uranium-based ceramics when it is considered that all reactors now in operation containing uranium-238 are producing plutonium. The most efficient utilization of plutonium ceramics, whether in thermal of fast reactors, will depend on the cost of plutonium relative to uranium-235, and on the behavior of the higher isotopes of plutonium in neutron fluxes of fast or thermal energies. Carbide-based fuels may have thermal conductivities up to five times greater than the oxides, a fact important for fast reactors. Phase diagrams, structure, and other properties are presented. The bibliography contains 42 references. (N.W.R.)

12836 RECENT DEVELOPMENTS IN ZIRCONIUM ALLOY CORROSION TECHNOLOGY. B. Cox (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Progr. in Nuclear Energy, Ser. IV, 4: 166-88(1961).

The development status of corrosion-resistant zirconium alloys for applications in nuclear engineering are reviewed along with some of the problems encountered. Problems discussed include stringer corrosion, hydrogen embrittlement, and oxidation and hydrogen absorption. The data given are primarily for Zircaloy-2 and -3. Results show that Zircaloy-3 has superior long-term corrosion properties. The bibliography contains 74 references. (N.W.R.)

12837 GAS-SOLIDS REACTORS IN URANIUM PROCESSING: A CRITICAL REVIEW. S. H. Smiley (Oak Ridge Gaseous Diffusion Plant, Tenn.). Progr. in Nuclear Energy, Ser. IV, 4: 191-278(1961).

The various developments in contractor design and performance associated with the preparation of large quantities of uranium hexafluoride and uranium metal are reviewed. Most of the discussion is concerned with the following chemical steps: the production of uranium trioxide from purified solutions of uranyl nitrate hexahydrate; the reduction of uranium trioxide to uranium dioxide with hydrogen; the reaction of uranium dioxide and hydrogen fluoride to produce uranium tetrafluoride; the conversion of uranium tetrafluoride, uranium oxides, and oxyfluorides to uranium hexafluoride with elemental fluorine; and the reduction of uranium hexafluoride with hydrogen to uranium tetrafluoride. The important features of reactor types developed for the feed production program are pointed out, and where possible, an analysis of reactor capability and potential is given. The bibliography contains 93 references. (N.W.R.)

12838 THE DESIGN AND OPERATION OF INDUSTRIAL SCALE PULSE COLUMNS FOR PUREX SERVICE. G. L. Richardson and A. M. Platt (General Electric Co., Richland, Wash.). Progr. in Nuclear Energy, Ser. IV, 4: 279-307(1961).

The development of current recommendations for Purex pulse column designs is discussed and reviewed. To obtain a better understanding of the radioactive solvent extraction process, a brief description of the Purex Process is offered in the form of a flowsheet. The advantages of the pulse column over the packed column and the mixer-settler are also discussed. The performance characteristics discussed include: flooding, pulse amplitude and wave shape, wetting characteristics and choice of continuous phase, sieve plate geometry, plate section height, column diameter, pulse frequency, volume velocity, flow ratio, solute concentration, temperature, backmixing, channeling, and entrainment. The design developments are given for the pulse generator, pulse column instrumentation, and seven different type columns employed in the Purex Process. The bibliography contains 16 references. (N.W.R.)

12839 APPLICATION OF CHEMICAL EXCHANGE METHODS TO ISOTOPIC SEPARATIONS. J. S. Drury (Oak Ridge National Lab., Tenn.). Progr. in Nuclear Energy, Ser. IV, 4: 308-48(1961).

The theory of isotope separation by chemical exchange is reviewed, and factors affecting the application of this separation method are discussed. The most important reactions involved in the separation of the isotopes of light elements are tabulated, and systems in which these reactions are used are described. The bibliography contains 50 references. (N.W.R.)

12840 PROCEDURES AND PRACTICES FOR THE DECONTAMINATION OF PLANT AND EQUIPMENT. A. B. Meservey (Oak Ridge National Lab., Tenn.). Progr. in Nuclear Energy, Ser. IV, 4: 377-98(1961). (CF-60-12-71)

The removal of radioactive contamination from the metal surfaces of chemical equipment and reactors is discussed and reviewed. The topics are on general decontamination of equipment, and specific decontamination methods for stainless steel, aqueous homogeneous reactors, fused fluoride salt processing equipment, sodium cooled reactors, aqueous heterogeneous reactors, liquid bismuth reactors, and gas-cooled reactors. The bibliography contains 136 references. (N.W.R.)

12841 THE CRITICALITY ASPECTS OF TRANSPORTATION OF FISSILE MATERIALS. E. R. Woodcock and H. C. Paxton (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng. and Los Alamos Scientific Lab., N. Mex.). Progr. in Nuclear Energy Ser. IV, 4: 401-34 (1961).

In the transport of fissile materials it is necessary to take precautions to guard against the possibility of a criticality excursion which could have serious consequences. Thus, the problems involved in removing the possibility of

such an occurrence are reviewed, with particular reference to practices in U. S. and U. K. and to the regulations prepared by the IAEA. Methods of ensuring safety are described. The bibliography contains 21 references. (N.W.R.)

12842 MONTE CARLO CRITICALITY CALCULATIONS. J. B. Parker and E. R. Woodcock (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng. and United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Progr. in Nuclear Energy, Ser. IV, 4: 435-57 (1961).

The Monte Carlo methods used in criticality studies have the important property that they are stochastically correct (i.e., the properties of the aggregate of neutron probes considered converge in probability to the appropriate true physical quantities provided that the input nuclear constants are correct) and are not dependent on methods of group approximation. The methods are also practical and detailed machine codes for solving problems by this method are discussed. Illustrations are given of the calculation of critical dimensions, respectively, of a reflected infinite slab, an unreflected infinite cylinder, a reflected infinite cylinder, and a water-reflected fissile metal core. (N.W.R.)

12843 RECENT DEVELOPMENTS IN THE STUDY OF METAL–WATER REACTIONS. Leo F. Epstein (General Electric Co., Pleasanton, Calif.). Progr. in Nuclear Energy, Ser. IV, 4: 461-83(1961).

The nature of metal–water reactions and their relation to reactor safety problems are discussed and reviewed. The rather involved steps through which a reactor system would have to pass to attain a dangerous metal–water reaction are described and explained; attention is given to the events which might occur. It is pointed out that there is an essential difference between physical and chemical explosions. In the physical case, the destructive agency is work, developed by the conversion of the thermal energy of the system. The chemical process, on the other hand, releases an additional amount of heat due to the reaction itself. The heat developed during a reaction of this kind is not inconsiderable and for some circumstances the chemical energy released may equal or exceed the amount of energy generated by the nuclear process which preceded the chemical step. The bibliography contains 43 references. (N.W.R.)

12844 CONTAINMENT OF FRAGMENTS FROM RUNAWAY NUCLEAR REACTORS. A Review of Model Studies carried out at Stanford Research Institute. Donald E. Davenport, George B. Huber, and Norman R. Zabel (Stanford Research Inst., Menlo Park, Calif.). Progr. in Nuclear Energy, Ser. IV, 4: 484-503(1961).

A modeling technique was devised for making detailed studies of reactor runaway and missile generation. Experiments to data were carried out on simplified reactor models which had no piping connections, test holes, control rods, or other connecting hardware and which used cold water as a moderator. The experiments show that the damage to the concrete shielding becomes less as the design of the primary container is strengthened and the gap which separates the container from the shielding is increased by providing for larger amounts of energy absorption in plastic flow of the container. The damage to the concrete shielding becomes greater as the period of the runaway becomes shorter and the fraction of energy going directly to gaseous products becomes larger. The three criteria, fragmentation, throw, and integrity are evaluated for both steel and concrete along with the velocity required to penetrate the containers. (N.W.R.)

BIOLOGY AND MEDICINE

General and Miscellaneous

12845 (NP-11423) EFFECT OF IRRADIATION ON CANNED PORK PRODUCTS. Report No. 9 (Final), July 12, 1956–July 11, 1961. John E. Thompson (Reliable Packing Co., Chicago). Contract QM R&D (Natick) No. 50 (Agreement). 9p.

The effect of irradiation on several canned pork products was studied. Fresh, ground ham patties were freeze-dehydrated to 1% moisture. A portion of these patties were then rehydrated to 7% and 50% moisture. Canned patties were irradiated at 1, 2, and 4 megarads and evaluated for irradiation flavor. The results indicated that the intensity of irradiation flavor increased with increased dosage in the 50% moisture samples only. No significant destruction of thiamine was found in fresh, ground ham patties, freeze-dehydrated to 1% moisture and irradiated 0, 1, 2.5, and 4.5 megarads; on the other hand, a characteristic destruction pattern of thiamine was observed in both the fresh control and completely rehydrated samples. About one third of the initial thiamine content was destroyed by the freeze-dehydration process. Fresh, ground ham was mixed with cured, canned, cooked, and irradiated at 0, 3.7, and 5.6 megarads. An untrained taste panel indicated no significant flavor preference for the non-irradiated control over the irradiated samples. A storage test showed that the shelf life of the control sample was considerably shorter than that of the irradiated samples. Pork bellies were cured and smoked, one for 12 hours and the other for 24 hours, then sliced, canned, and irradiated at 4.5 megarads. No undesirable flavors and no destruction of smoke flavor due to irradiation were detected. Additional post-irradiation storage test coupled with flavor evaluation indicated a preference for the less smoked bacon. Storage temperatures did not affect the product quality. (auth)

12846 (NP-11425) RADIATION PRESERVATION OF POULTRY PRODUCTS. Report No. 3 (Final), June 1, 1959–February 28, 1961. Hans Lineweaver (Department of Agriculture. Western Utilization Research and Development Div., Albany, Calif.). Contract QMREC-59-F&CI-2. 6p.

The adverse odor, flavor, and color changes occurring in enzyme-inactivated chicken irradiated at 4.6 rad can be significantly reduced by appropriate procedures. Odor and flavor changes can be reduced by selection of an appropriate cooking method. Odor, as reported by others, is markedly reduced by the incorporation of charcoal packets in the containers during storage at elevated temperatures. Deep-fat frying was more effective in reducing off flavors than other cooking methods tested. The objectionable pink color observed in irradiated chicken is a change that develops during storage of the irradiated chicken at elevated temperatures, and not a change occurring during the irradiation process. Enzyme inactivated (155°F, 45 min) irradiated chicken stored in N_2 at –30°F following irradiation did not develop pink color. Stored in an air atmosphere, it developed little pink color after 3 months at 100°F while that stored in a N_2 atmosphere became objectionably pink as was reported previously. Although samples in a nitrogen atmosphere containing 2% oxygen (the proportion of O_2 expected in commercial N_2 canning) developed slightly less pink color than those in a 100% N_2 atmosphere, the difference was not marked enough to constitute a practical improvement. On the other hand, the degree of heat treatment applied for enzyme inactivation had a marked influence on pink color development during subsequent storage of irradiated chicken. No pinkness developed in samples heated to 185°F. Such samples are essentially completely cooked samples. Objectionable pinkness developed in samples heated to 155°F and held at that temperature for 45 minutes. It appears that a partial or complete cook is a practical approach to elimination of the pink color defect. (auth)

12847 (AEC-tr-5051) STERILITY MUTATIONS IN DROSPHILA MELANOGASTER 1. DISTRIBUTION OF STERILITY MUTATIONS IN THE CHROMOSOMES OF DROSOPHILA MELANOGASTER. R. L. Berg. Translated for Oak Ridge National Lab., Tenn., from Trudy Leningrad. Obshchestva Estestvoispytatelei, 67: No. 4, 96-108(1938). 24p.

The distribution of male and female modifiers in the chromosomes of Drosophila melanogaster was investigated. The frequency of sterility mutations occurring in the x-chromosome and in the autosomes under the influence of x rays was studied. An experiment was carried out to determine the frequency of sterility mutations affecting females only, occurring after irradiation in the x-chromosome. The C1B method was used for this purpose. Results indicated that sterility mutations are more numerous in the x-chromosome than in the autosome. In the x-chromosome the number of sterility mutations affecting males was not less than that of lethals. Among 2245 F_2 cultures examined, 247 lethals were found. Among 1874 cultures examined for sterility mutations, 208 mutations were observed. In the autosomes sterility mutations were much less frequent than lethals. Among 703 cultures examined for lethals, 162 mutations were observed, while among 479 cultures examined for sterility mutations, only 16 mutations were found. In the x-chromosome, sterility mutations affecting males were more numerous than those affecting females. (auth)

12848 HUMAN TOLERANCE TO MAGNETIC FIELDS. Dietrich E. Beischer (Naval School of Aviation Medicine, Pensacola, Fla.). Astronautics, 7: No. 3, 24-5; 46; 48(Mar. 1962).

The physiological and psychological effects of magnetic fields on man were studied. There was no sensation in part and entire body exposure to non-changing fields up to 20 kilogauss for a duration of 15 minutes, and no after-effects following exposure to fields of 5 kilogauss for less than three days per year per man. However, taste and pain sensation may be caused by fillings of the teeth in high strength fields. Visual sensations are also noticed in alternating fields. (N.W.R.)

12849 TRITIUM AND CARBON-14 IN THE TREE RINGS. Kunihiko Kigoshi and Yoshio Tomikura (Gakushuin Univ., Tokyo). Bull. Chem. Soc. Japan, 34: 1738-9(Nov. 1961). (In English)

Measurements were made of the concentration of C^{14} and tritium in the tree rings of recent years in order to obtain the annual mean concentration of the atmospheric C^{14} and of the tritium in the rain water. The data on C^{14} showed a tendency of the concentration to decrease after 1960, and it seemed to have a maximum value at the beginning of 1960. The same was true for tritium concentrations. The data suggested a stratospheric residence time of 1 to 2 years. (M.C.G.)

12850 VARIATION OF THE ATMOSPHERIC CARBON-14 IN RECENT YEARS AT TOKYO. Kunihiko Kigoshi and Kunihiko Endo (Gakushuin Univ., Tokyo). Bull. Chem. Soc. Japan, 34: 1739-40(Nov. 1961). (In English)

Measurements were made of the atmospheric C^{14} in Tokyo. The CO_2 in the air was collected by absorption in NaOH solution and the radioactivities measured. Large fluctuations are shown in the data which might be due to the nature of the air mass at the collection dates. (M.C.G.)

12851 ANALYSIS OF GIANT POLYNUCLEAR CELL FORMATION CAUSED BY HVJ VIRUS FROM EHRLICH'S ASCITES TUMOR CELLS. II. QUANTITATIVE ANALYSIS OF GIANT POLYNUCLEAR CELL FORMATION. Yoshio Oakada and Jun Tadokoro (Osaka Univ.). Exptl. Cell Research, 26: 108-18(Feb. 1962). (In English)

The determination of cell number, DNA content, and number of nuclei along the course of giant polynuclear cell formation in HVJ-ETC system led to the conclusion that giant polynuclear cell formation in this system is due to fusion of the tumor cells themselves and not to any kind of cell growth. The decrease in cell number during the fusion reaction indicates the degree of cell fusion. The grade of the fusion reaction can be quantitatively expressed by the fusion index: Fusion index = (Cell number in non-virus control tube/Cell number in test tube) −1.0. The fusion reaction required the adsorption of many virus particles onto the cells, i.e. 1300 adsorbed virus particles per cell was required of 50% decrease of the cell number, and the grade of fusion increase with increasing number of adsorbed virus particles. The fusion activity of HVJ is a new character differing from other activities such as infectivity, hemagglutinating activity, hemolytic activity, and sialidase activity of the virus. (auth)

12852 ANALYSIS OF GIANT POLYNUCLEAR CELL FORMATION CAUSED BY HVJ VIRUS FROM EHRLICH'S ASCITES TUMOR CELLS. III. RELATIONSHIP BETWEEN CELL CONDITION AND FUSION REACTION OR CELL DEGENERATION REACTION. Yoshio Okada (Osaka Univ.). Exptl. Cell Research, 26: 119-28(Feb. 1962). (In English)

Aerobic conditions are essential for polynuclear giant cell formation of ETC by HVJ virus. Optimum pH range of the reaction is 7.3 to 7.6 and at low temperatures, such as 23°C, the fusion efficiency decreases. When an HVJ–ETC mixture is incubated without shaking or under anaerobic conditions or in the presence of DNP at 37°C for 60 min, cells agglutinated by HVJ disaggregate freely and cell degeneration appears. From these results, it seems that the fusion reaction is initiated not only by the activity of the virus, but the metabolic activity of the participant cells is also essential. Cell degenerating activity of HVJ is independent from its fusion activity, and it may have a close relationship with its hemolytic activity. There is, however, a difference between the hemolytic action and the cell degenerating action; under suitable conditions, cell degeneration is repaired by the cell itself and only under conditions of metabolic inhibition does the reaction occur. In contrast, hemolysis is completed under all conditions studied. (auth)

12853 A PUBLIC HEALTH APPLICATION OF IRRADIATION PROCESSING. THE ELIMINATION OF SALMONELLAE FROM FROZEN EGG. D. N. Rhodes (Low Temperature Research Station, Cambridge, Eng.). Food Irradiation, 2: No. 2, A10(Oct.-Dec. 1961). (In English)

Irradiation processing of frozen eggs for the elimination of Salmonellae was found to be simple and reliable. A slight odor and off-flavor of the product was the only disadvantage. Results are compared with those obtained with heat pasteurization. (C.H.)

12854 GAMMA IRRADIATION OF FRUIT. PRELIMINARY PHYSIOLOGICAL STUDIES. Roger J. Romani, Jan van Kooy, and Betty Jane Robinson (Univ. of California, Davis). Food Irradiation, 2: No. 2, A11-A13(Oct.-Dec. 1961). (In English)

Results are presented from studies on the effects of γ radiation on physiological and biochemical processes in pears, cherries, and strawberries stored at 59°F under aeration. Data are given on respiration rates, vitamin C content, and storage life of irradiated fruit. (C.H.)

12855 REGIONAL PULMONARY FUNCTION STUDIED WITH XENON^{133}. W. C. Ball, Jr., P. B. Stewart, L. G. S. Newsham, and D. V. Bates (McGill Univ., Montreal). J. Clin. Invest., 41: 519-31(Mar. 1962).

A radioactive isotope of the inert gas, xenon, was used in conjunction with externally placed scintillation counters to estimate separately the function of six different regions of the lung. By comparison of external counting rates after a single breath and after rebreathing an air-xenon mixture, it has been possible to compute an index of relative ventilation that is independent of the volume of lung within the counting field. Determinations were made at two levels of inspiration in order to compare the distribution during normal quiet breathing with the distribution after a single full inspiration. By the intravenous injection of dissolved xenon^{133} during breath holding, the relative perfusion of lung in different regions has been determined. In 21 seated normal subjects, it was found that the lower portion of the lung is somewhat better ventilated than the upper portion, but receives a much greater fraction of the total pulmonary blood flow; the distribution of inspired air is slightly more uniform on deep inspiration than during quiet breathing; the middle and lower portions of the lung are better ventilated on the left than on the right during deep inspiration; and the lower portion of the lung is probably better perfused on the right than on the left. Forty patients with various cardiac or pulmonary disorders were studied, and four illustrative cases are presented. Two of these illustrate the differences in regional distribution of disordered function that may occur in patients with pulmonary emphysema. The third patient demonstrates the value of the technique in assessing lobar function after transposition surgery, and the fourth patient illustrates normally distributed ventilatory function despite a disturbed distribution of perfusion in uncomplicated mitral stenosis. The advantages and disadvantages of this method in comparison with the oxygen^{15} technique of West and co-workers are discussed. It appears that the xenon technique described is capable of extensive application to both investigative and clinical problems. (auth)

12856 STERILIZATION BY IRRADIATION. U. K. PROGRESS IN SURGICAL INDUSTRY. Nuclear Eng., 7: No. 70, 104-9(Mar. 1962).

The problems, feasibility, and economic aspects of radiosterilization of medical supplies are discussed and described along with the design and operation of two types of plants for radiosterilization. The plants are basing their designs on a vertical chain conveyor and monorail systems. The plants are based on the use of gamma radiation. A brief comparison is given of electron and gamma irradiation for radiosterilization of medical supplies. (N.W.R.)

12857 DEMONSTRATION OF F_1 HYBRID ANTI-PARENT IMMUNOLOGICAL REACTION. Franco Celada and W. J. Welshons (Oak Ridge National Lab., Tenn.). Proc. Natl. Acad. Sci. U. S., 48: 326-31(Mar. 1962).

By the use of a quantitative assay method based on spleen

cell grafting, the existence of an F_1 hybrid anti-parent immunological reaction, that could not be detected by skin grafting, was demonstrated. The antigen(s) involved in this reaction appeared to be considerably weaker than the H-2 antigens and are of the same order of magnitude as the Y-chromosome antigen(s). (auth)

12858 COMPLEMENTATION AND RECOMBINATION AMONG PYR-3 HETEROALLELES OF NEUROSPORA CRASSA. Val W. Woodward (Rice Univ., Houston, Tex.). Proc. Natl. Acad. Sci. U. S., 48: 348-56(Mar. 1962).

Comparison between a genetic and a complementation map of the pyrimidine-3 locus of Neurospora is presented. The exceptions to co-linearity are numerous. Several pairs of mutants shown to be allelic by one criterion are nonallelic by the other criterion; strikingly, homoallelic multisite mutants complement. One possible explanation of this finding is discussed. The complementation pattern of one mutant can be changed by ultraviolet induction of a mutation that resembles an intragenic-suppressor. The new mutation was not separated from the pyr-3 locus in more than 750 progeny tested thus far. It is specific for the KS-23-KS-43 combination, and it does not change either the reverse mutation rate of KS-23 or the map distances between KS-23 and other pyr-3 mutants. (auth)

12859 A NUMBER OF PROBLEMS OF SPACE BIOLOGY. O. G. Gazenko. Vestnik Akad. Nauk S.S.S.R., 32: No. 1, 30-4(Jan. 1962). (In Russian)

The three main problems in the field of space biology are the effect of external, space factors on living organisms, the development of biological methods of supporting life during space travel and on various planets, and a study of the conditions necessary for extraterrestrial life. The external factors include (1) weightlessness, and the effects of noise, vibration and acceleration (2) the effects of various forms of radiation and heat (3) the effects of isolation, cramped quarters, feeding etc. The electrocardiogram results on Gagarin and Titov show that the pulse rate fluctuates somewhat more widely under the prolonged effect of weightlessness. Titov developed symptoms of seasickness such as dizziness and weakness. These symptoms abated somewhat, after he went to sleep, but did not disappear completely. It is believed that the receptors of a number of afferent systems in the body were affected by weightlessness. The available data indicate that some shielding will be necessary to protect man from radiation during space flight. Genetic data from insects and plants aboard the space ships are being accumulated. (TTT)

12860 PROCESS FOR CONTROLLING ANIMAL GROWTH RATE. Willard J. Visek (to U. S. Atomic Energy Commission). U. S. Patent 3,029,184. Apr. 10, 1962.

A method of injecting growing animals with the enzyme urease subcutaneously in increasing dosages is described; this generates within the blood anti-urease which enters the intestinal tract and inhibits the enzymatic decomposition of urea by urease in that location. Ammonia, one of the decomposition products, is thereby kept from diffusing through the intestinal walls into the blood, and this greatly reduces the energy requirements of the liver for removing the ammonia, thereby increasing the feeding efficiency of the animals. (AEC)

Biochemistry, Nutrition, and Toxicology

12861 (TID-15061) THE BIOSYNTHESIS OF TERTHIENYL. [Progress Report], June 7, 1961–February 15, 1962. (Michigan State Univ., East Lansing). Contract AT(11-1)-1034. 4p.

The preparation of terthienyl, degradation reactions of terthienyl, isolation of terthienyl from marigold blooms and roots, conditions for growing marigold plants in the laboratory, and the isolation of three unknown compounds of possible relation to terthienyl from marigolds are discussed. (M.C.G.)

12862 (TID-15299) PHOSPHORUS METABOLISM IN LAMBS FED VARYING PHOSPHORUS INTAKES. Progress Report. [Missouri. Univ., Columbia]. Feb. 20, 1962. Contract AT(11-1)-1011. 4p.

Phosphorus deficiency was produced in growing wether lambs as evidenced by reduced growth, feed consumption, plasma inorganic phosphorus level, and phosphorus balance. P^{32} was administered at this time and its partition into various body components and excretory products is being determined. Radiation effects of internal P^{32} were tentatively examined, and it would appear that some effects were noted which may be greater on a low phosphorus intake. (auth)

12863 NEW CONCEPTS AND FUTURE TRENDS IN TOXICOLOGY. Herbert E. Stokinger (U. S. Public Health Service, Cincinnati). Am. Ind. Hyg. Assoc. J., 23: 8-19 (Jan.-Feb. 1962).

New concepts and procedures derived from related fields of biochemistry, pharmacology, immunochemistry, and genetics, are now at the disposal of the industrial toxicologist to aid in the solution of problems in two broad areas of investigation, early indicators of response to toxic agents and mechanisms of toxic stress. Several ways of using body metabolites, tissue enzymes, alone and in combination, and tissue metals for the detection of early responses to toxic agents while the responses are still reversible are given. Immunochemical changes not heretofore recognized are now shown to be often a response to inhaled chemicals. Highlighted are mechanisms of action of CCl_4, oxidant gases, radiomimetic chemicals, organic phosphate insecticides, and other substances of industrial interest. (auth)

12864 PHOSPHATE PARTITION IN THE ERYTHROCYTES OF NORMAL NEWBORN INFANTS AND INFANTS WITH ERYTHROBLASTOSIS FETALIS. III. P^{32} UPTAKE AND INCORPORATION. Tibor J. Greenwalt, V. E. Ayers, and S. A. Morell (Milwaukee Blood Center). Blood, 19: 468-78(Apr. 1962).

The uptake and incorporation of $P^{32}O_4$ by the cord blood erythrocytes of normal and erythroblastotic infants and the erythrocytes of adults was studied by incubating specimens in ACD at 37°C in air. The uptake of P^{32} from the plasma was slower in the infants than in the adults. It was possible to demonstrate an initial fast phase followed by a slow phase in all the plasma P^{32} uptake experiments. The half-value time and the percentage turnover per minute indicated greater activity in the adults compared to the infants. The balance of movement of phosphorus was from red cells to plasma in all the experiments. No striking differences in phosphate metabolism were demonstrated between the normal and erythroblastotic newborns, except for the large turnover in μm of P per minute by the red cells of the latter during the first 20 minutes of incubation. Labeling of intraerythrocytic inorganic phosphorus (P_i), adenosine triphosphate (ATP) and 2,3-diphosphoglycerate (2,3-DPG) proceeded more slowly in the infants than in the adults. The labeling of the erythrocyte 2,3-DPG of all the infants lagged far behind P_i and ATP whereas in the adults the relative specific activity (rsa) of 2,3-DPG had equalled or exceeded the rsa of P_i and ATP in four hours. It is suggested that there is decreased synthesis of phosphoglycer-

ates by the erythrocytes of the newborn which may be due to a lower level of glyceraldehyde-3-phosphate dehydrogenase activity. (auth)

12865 CYTOPATHIC EFFECTS OF DEUTERIUM OXIDE ON THE MALE GONADS OF THE MOUSE AND DOG. A. P. Amarose and Dorice M. Czajka (Argonne National Lab., Ill.). Exptl. Cell Research, 26: 43-61(Feb. 1962). (In English)

In CF No. 1 male mice maintained on 30% deuterium oxide in their drinking water the cytological observations on the testes revealed the formation of multinucleated cells containing only spermiogenic elements. Exfoliation of spermatocytes and a disruption of the stages in the seminiferous cycle were also noted. The epididymides of the CF No. 1 mice showed, after 40 days treatment, a complete absence of spermatozoa and a great deal of debris from the tubules of the testis. C-57 black male mice showed the testicular anomalies seen in the CF No. 1 mice plus an absence of spermatogenic cells. Observations on the testis of the dog were similar to those seen in the CF No. 1 mice. Since no visible evidence of necrobiosis was seen in the testes or epididymides of the deuterated mice, it is suggested that the meiotic divisions in all the deuterated mice were completed but that a block in the differentiation of the daughter cells accounts for the anomalies noted. (auth)

12866 MINERALIZATION IN STUNTED BONE. ALPHARADIOGRAPHIC AND MICRORADIOGRAPHIC STUDY. J. Vincent, L. F. Bélanger, and B. B. Migicovsky (Université Lovanium, Leopoldville, Congo; Univ. of Ottawa; and Dept. of Agriculture, Ottawa). Exptl. Cell Research, 26: 168-74(Feb. 1962). (In French)

Phase contrast, alpha radiography, and microradiography were used in a study of the tibias of rachitic chickens. The cartilage displayed calcareous globules which were less abundant, larger, and more slowly agglomerating. Extratrabecular crystals were slowed by the three procedures. Numerous osseous spans had in their axes a band where the organic material has become transparent to α particles and where the mineral salts have disappeared after radiography. The respective advantages of microradiography and alpha radiography are discussed. (tr-auth)

12867 EFFECTS OF FOWL SARCOMA VIRUS ON P^{32} INCORPORATION INTO NUCLEIC ACID IN CHICKEN THYMUS GLAND. Tetsuya Takahashi, Minoru Ishizawa, and Tomoya Kamiya (Kyushu Univ., Fukuoka, Japan). Gann, 52: 271-6(Dec. 1961).

An investigation was made of P^{32} uptake into DNA and RNA of chicken thymus gland in vitro at different stages of tumorigenesis caused by chicken sarcoma virus (Chiba's strain). Specific activities for the different portions of tumor were compared. The solid portion and the rudimentary thymus gland were on a similar level and the jelly-like portion was lower. From the 3rd to 7th day after virus inoculation, the specific activity of RNA was depressed, and from the 8th day this value increased compared with that of control. Specific activity of DNA changed also accompanied that of RNA. It was concluded that specific activities of RNA and DNA express cell reproduction, and there was no expression of the activity of RNA and DNA fractions occurred from the 3rd to 7th day after virus infection. However the reason for the decrease is not clarified. (auth)

12868 STUDY ON THE REMOVAL OF RADIOSTRONTIUM BY MEANS OF CHELATING AGENTS. A. Catsch (Institut für Strahlenbiologie, Kernforschungszentrum, Karlsruhe). Intern. J. Radiation Biol., 4: 75-83(Oct. 1961). (In German)

The influence of chelating agents and isotopic dilution on the metabolism of carrier-free Sr^{85} in rats was studies. The early administration of the $SrNa_2$-chelate of the 2:2'-bis [di(carboxymethyl)amino] diethylether reduced the skeletal deposition of Sr^{85} by 40 to 50%, whereas the delayed treatment proved ineffective. A theoretical discussion on the interaction of chelates and isotopic dilution is given. (auth)

12869 NUCLEOTIDES IN THE METABOLISM OF YEAST AND P^{32}. M. F. Abdel-Wahab (Atomic Energy Commission of UAR, Cairo). Isotopentechnik, 1: 243-5 (Nov. 1961). (In German)

The concentrations of free nucleotides in acid extracts from yeast, which had adsorbed phosphate under anerobic conditions, and from growing and sporulating yeasts were determined with the help of chromatography on basic ion exchangers. In both cases, characteristic variations are shown with respect to the concentrations of free nucleotides in acid extracts from yeasts grown under other conditions. In the anerobic yeast enriched with phosphate, considerably greater masses of polyphosphorylated nucleotides were found than elsewhere. (tr-auth)

12870 STRONTIUM-90 TOXICITY IN MICE. L. M. van Putten and M. J. de Vries (Radiobiological Inst. TNO, Rijswijk, Netherlands). J. Natl. Cancer Inst., 28: 587-603(Mar. 1962).

A single injection of strontium-90 was administered to groups of female mice at 2 dose levels. Survival and the causes of death were studied. The results in shortening of the lifespan and in frequency of bone tumor parallel data previously reported. Analyses of the causes of death showed that in experimental and control mice more than 80% died with tumors. Special emphasis was put on the exact histological classification of the types of tumor. The influence of internal radiation of Sr^{90} on incidence of the different types of tumor could be evaluated only by plotting specific death rates. (auth)

12871 RECOIL-FREE γ-RAY TRANSITION OF Fe^{57} IN THE BLOOD COMPONENT HEMIN. Ulrich Gonser (North American Aviation, Inc., Canoga Park, Calif.). J. Phys. Chem., 66: 564-5(Mar. 1962).

An investigation was made to search for the recoil-free γ transition of Fe^{57} in blood and in blood components. Using a single crystal of hemin, a directionally dependent Mössbauer effect can be expected. The recoil energy for a free iron atom, a rigid hemin molecule, a hemoglobin molecule, and one red cell emitting or absorbing a 14.4 kev γ ray is given according to the equation E_R (atom = $E/2mc^2$. A source of Co^{57} diffused in Cu was used. The absorber consisted of 135 mg hemin/cm^2 held between thin aluminum foils mounted in a holder and connected to a liquid nitrogen cryostat. It was found that the hemin curve shifted toward the center (zero velocity) by a very small amount (about 0.01 cm/sec) and the line width was nearly twice as large. The isomer shift (or chemical shift), which is a measure of the electron density at the nucleus, was indicative of the chemical binding of the iron atom. (P.C.H.)

12872 METABOLIC BEHAVIOUR OF ^{137}Cs–^{137m}Ba IN THE LACTATING GOAT. R. H. Wasserman, C. L. Comar, and A. R. Twardock (Cornell Univ., Ithaca, N. Y.). Intern. J. Radiation Biol., 4: 299-310(Jan. 1962). (In English)

Investigations on the metabolism of Cs^{137} in the lactating

goat demonstrated that the biological half-time for removal of Cs^{137} from the body was about 2 to 3 days. At steady state, about 7% of the daily dose of ingested Cs^{137} was secreted daily in milk, about 40% in the urine, and about 40% in the feces. The Cs^{137}/K ratio in milk was 1.4 based on a dietary Cs^{137}/K ratio of unity. The mammary gland did not differentiate between Cs^{137} and K, and the organ of highest concentration was kidney, with values 1.5 times that of muscle and other soft tissues. The Ba^{137m} daughter metabolically dissociated from its Cs^{137} parent in vivo so that the gamma activity of the whole blood of the living animal was 5.5 times that as usually determined. These and other findings are discussed and reference made to differences in Cs^{137} metabolism between ruminants and non-ruminants. (auth)

12873 INFLUENCE OF CHELATING AGENTS ON THE DISTRIBUTION OF COBALT-60 IN ALBINO RATS. V. M. Sivaramakrishnan, N. G. Sreenivasan, T. N. Sekhara Varma, and S. Brahmanandam (Cancer Inst., Madras). Nature, 193: 1195-6(Mar. 1, 1962).

Sixteen chelating agents, of which five form insoluble complexes (1-nitroso 2-naphthol, sodium diethyldithiocarbamate, oxine, rubeanic acid, and salicylaldehyde) were used. Male albino rats, weighing 200 to 300 g, received intravenously 0.5 ml of carrier-free Co^{60} solution (about 16 μc) and either 0.5 ml of isotonic saline (the controls) or 0.5 ml 5 mM solution of one of the chelating agents at pH about 7.0. After 24 hr the rats were killed, and the radioactivity in various organs, in a weighed specimen of blood, and in the urine and feces collected separately was determined. Most of the chelating agents tested caused profound changes in the distribution of the isotope. Many of the chelating agents caused decreased excretion (for example, only 17% with 1-nitroso 2-naphthol) and preferential localization in various organs. Among the prominent changes were localization of the isotope in the reticuloendothelial system (for example, liver and spleen) by rubeanic acid and BAL, in the lungs by oxine, in the carcass (muscles, bones, and skin) by 1-nitroso 2-naphthol, and slightly in the intestinal contents by sodium diethyldithiocarbamate, which largely increased the fecal excretion from 5 to 35%. An attempt to explain the varied effects of these and other chelating agents is given. (P.C.H.)

12874 UPTAKE OF RADIOSTRONTIUM BY AN ALGA, AND THE INFLUENCE OF CALCIUM ION IN THE WATER. D. C. Pickering and J. W. Lucas (Coll. of Tech., Liverpool). Nature, 193: 1046-7(Mar. 17, 1962).

The uptake of radiostrontium by the algae Rhizoclonium hieroglyphicum was studied with respect to the effects of Ca^{2+} ions in the water. Equilibrium between the algae and the water (pH 5.8) was found to be reached in ~10 days. The Sr and Ca results for the algae are presented as plots of the logarithm of the concentration factor of Sr or Ca in the algae vs the logarithm of the Ca^{2+} concentration in water (μM/g), and the curves are fitted by the equations $\log CF_{Sr} = 2.17 - 1.05 \log [Ca^{2+}]$ and $\log CF_{Ca} = 2.16 - 0.935 \log [Ca^{2+}]$. The calculated discrimination factor (Sr/Ca) shows that the algae discriminates in favor of Sr at low Ca^{2+} concentrations. (D.L.C.)

12875 MASSIVE-DOSE RAPID PALLIATIVE RADIOTHERAPY. A Preliminary Report. W. D. Horrigan, H. L. Atkins, and N. duV. Tapley (Columbia Univ., New York). Radiology, 78: 439-44(Mar. 1962).

Massive x-ray doses at intervals of one week were used as a feasible method in palliative therapy of advanced malignant disease. It is felt that theoretical and practical advantages exist to justify this mode of therapy. However, an increased incidence of radiation injury may result unless careful selection of patients and limitation of total dose is exercised. (auth)

12876 AUTORADIOGRAPHIC RESOLUTION OF DOUBLY LABELED COMPOUNDS. E. S. Kempner and J. H. Miller (National Inst. of Arthritis and Metabolic Diseases, Science, 135: 1063-4(Mar. 23, 1962).

The autoradiographic technique was used on chromatograms containing adenosine diphosphate ($ADP\text{-}P^{32}$) and $ADP\text{-}8\text{-}C^{14}$. Adenosine diphosphate-8-C^{14} gave an intense exposure only on film 1, while $ADP\text{-}P^{32}$ darkened both films, the second film being twice as dark as the first. However, the relatively short half-life of P^{32} (14.3 days) permits a resolution to be made after an appropriate decay. It was concluded that, in general, when C^{14}-P^{32} or S^{35}-P^{32} chromatograms contain only one radionuclide per spot, visual comparison of the two films permits a simple identification of the material. Under some conditions, doubly labeled spots may also be resolved. (P.C.H.)

12877 IODINE-125 AS A PROTEIN LABEL IN IMMUNOLOGY. Frank W. Fitch, James Winebright, and Paul V. Harper (Argonne Cancer Research Hospital, Chicago). Science, 135: 1068-9(Mar. 23, 1962).

Advantages of using I^{125} as a protein label in immunology are given. The 60-day half-life provides long shelf life for labeled materials, and the low energy dissipation rate, approximately 15% that of I^{131}, greatly reduces radiation damage to tagged compounds. Formalin-killed Salmonella typhosa bacilli were iodinated with I^{125} and injected intravenously into rats. Tissues sampled for measurement of radioactivity and for autoradiography showed an average of 77% of the injected radioactivity was present in the liver and 2.5% in the spleen. (P.C.H.)

Fallout and Ecology

12878 (PG-Report-288) THE ACCUMULATION OF STRONTIUM-90 AND YTTRIUM-90 FROM A CONTINUOUSLY FLOWING NATURAL WATER BY EGGS AND ALEVINS OF THE ATLANTIC SALMON AND THE SEA TROUT. V. M. Brown (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 16p.

Eggs of salmon and sea-trout were immersed in Sr^{90} and Y^{90} contaminated water. At secular equilibrium the eggs were thirty times more radioactive than the water, weight for weight, the particular level of specific activity over the whole egg-stage showing a positive linear correlation with that of the water (within the limits of the experiment). Most of this radioactivity was associated with the protective egg-membranes. Newly hatched fish were approximately twice as radioactive as the water but with growth rapidly accumulated the two isotopes. Egg mortality was not significantly increased by contamination. (auth)

12879 BERYLLIUM-7 AND FISSION PRODUCTS IN SURFACE AIR. R. P. Parker (Royal Cancer Hospital, London). Nature, 193: 967-8(Mar. 10, 1962).

Results are presented for the measurements of Be^7 during the period Jan. 1960 to Sept. 1961 and of Ce^{144} and Cs^{137} during the period Jan. to Sept. 1961 in surface air sampled at Sutton, Surrey (51°N, 0°). Maxima in the months of April and May are noted for all three nuclides, and the results are compared with the work of other investigators. (D.L.C.)

Radiation Effects on Living Tissues

12880 (AD-262370) A STUDY OF BONE CHANGES IN ALBINO RATS SUBJECTED TO LOW INTENSITY Co-60 GAMMA RADIATION. Annual Progress Report No. 4, September 1, 1960–August 31, 1961. Pauline Beery Mack (Texas Woman's Univ., Denton. Nelda Childers Stark Lab. for Human Nutrition Research). Aug. 31, 1961. 51p.

Albino rats were irradiated at 2, 5, 10, and 20 r/day from conception through the period of weaning, and for 119 days subsequent to weaning. Those irradiated at 20 r were found at weaning to have skeletons approximately 8% smaller and tibia densities approximately 25% lower than the nonirradiated control animals. When the radiation was continued after weaning, they gained somewhat in size but did not attain a size equivalent to the controls. Their skeletal density values were lower than the controls throughout. The animals receiving 10 r performed similarly with respect to tibia growth, but their skeletal density was no less than that of the controls. Lesser levels of radiation did not cause effects as definite as the 10 and 20 r levels. Bone strength was affected adversely by the radiation at 10 and 20 r. (auth)

12881 (TID-3569) RADIOBIOLOGICAL REVIEW ARTICLES. A Literature Search. Charlie M. Pierce, comp. (Division of Technical Information Extension, AEC). Jan. 1962. 73p.

A list of 1765 references is presented on all biological activities which are influenced by radiant energy. Most of the references are journal articles and are primarily of a review nature. (C.H.)

12882 (TID-14882) ENZYMATIC AND BIOCHEMICAL STUDIES OF EPIDERMIS WHICH HAS BEEN IRRADIATED WITH BETA PARTICLES. Progress Report, February 1, 1961–January 1, 1962. (Albert Einstein Medical Center, Philadelphia). Contract AT(30-1)-1727. 27p.

The effects of 300-, 600-, and 3000-rep β doses on epidermal nucleases, viz. an acid DNase (DNase II, pH range 4.5 to 5.0) and a basic DNase (DNase I, pH 7.4), are examined. The effects of these irradiations on the relative epidermal concentrations of extracellular and cell-bound Mg^{2+}, on the epidermal concentrations of urea, ammonia, and free amino acids, and on skin tumor incidence are also studied. Optimal conditions are found for determinations of epidermal DNase I and DNase II, phosphatases, adenosine-5′-nucleotidase, adenosine-5′-deoxyribonucleotidase, adenosine triphosphatase, and thymidine-5′-monophosphatase. The catabolism of purine and pyrimidine compounds is investigated. (T.F.H.)

12883 (TID-15001) THE ACTION OF RADIATION AND OTHER MUTAGENIC AGENTS (1) IN INDUCING MUTATION IN DROSOPHILA FEMALES, AND (2) IN CONTROLLING THE ACTION OF SPECIFIC GENES RESPONSIBLE FOR SUPPRESSING UNCONTROLLED GROWTH. Report Covering 9-Year Period, May 1, 1953–April 30, 1962. H. Bentley Glass (Johns Hopkins Univ., Baltimore). Feb. 8, 1962. Contract AT(30-1)-1472. 22p.

Studies of the comparative mutagenic effects of ionizing radiations on males and females of Drosophila melanogaster are described. Sex-linked recessive lethal mutations were induced in nitrogen, air, and oxygen at doses of 1000, 2000, 3000, and 4000 r. The frequencies of mutations obtained in spermatozoa were uniformly about one-third higher than the frequencies obtained for the same dose and condition of atmosphere in mature oocytes. The relative frequencies of recessive autosomal lethals in mature male and female germ cells were identical with the relative frequencies of sex-linked recessive lethals. In studies of point mutations and deficiencies involving specific loci, the rates in the male germ cells exceeded those in the female germ cells by a proportion equal to that found to apply to autosomal and sex-linked recessive lethals. Spontaneous mutation rates were determined for a number of specific loci marked by recessive genes used in the tested stocks. Fertility was lost in both males and females when they were x-rayed as 80-hr-old larvae and bred upon emerging as adults. Females recovered their fertility rapidly but the males did so at a much slower rate. The "brown; scarlet" stock was found to carry two mutants each suppressed by a particular suppressor gene. It was concluded that the two suppressors act along different metabolic pathways departing from tryplophan, but both involving an x-ray-sensitive step. A study was made of the effects on the life span of two different mating regimens: immediate and deferred. It was found that the lines previously subjected to immediate mating significantly outlived the lines previously subjected to deferred mating when the mating regimen in the test was immediate mating. Exactly the opposite happened when the mating regimen in the test was deferred mating. (M.C.G.)

12884 (AEC-tr-5052) ON THE PROBLEM OF THE RADIATION SENSITIVITY OF DRY SEED. A. Micke and K. Woehrmann. Translated by Lydia Venters (Argonne National Lab., Ill.) from Atompraxis, 6: 308-16(1960). 18p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 22765.

12885 (FTD-TT-62-183) INCREASED SUSCEPTIBILITY TO DENTAL CARIES INDUCED BY IONIZING RADIATION. Yu. A. Fedorov. Translated from Doklady Akad. Nauk S.S.S.R., 140: 1195-8(Oct. 11, 1961). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 4121.

12886 (NP-tr-860) THE EFFECT OF X-IRRADIATION ON POTATOES (SOLANUM TUBEROSUM L.) AND JERUSALEM ARTICHOKES (HELIANTHUS TUBEROSUS L.). Chr. Paetzold and W. Kolb. Translated by L. Rowe (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Beitr. Biol. Pflanz., 33: 437-58 (1957). 37p.

X ray doses of 250 to 16000 r retard or suppress sprouting in potato tubers. Weekly irradiated or untreated small or medium size tubers sprout more slowly than large ones. But after a long storage period they show relatively greater sprouting and in part a greater weight loss than medium size or large tubers. After stronger irradiation without additional filters the situation is partly reversed. The sprout weight and weight loss from large tubers is greater than with small tubers. Irradiation of the crown acts more intensively than that of the navel. Strong irradiation of damaged tubers causes relatively large weight losses. Irradiation does not have a uniform effect on the constituent materials in the varieties investigated. After long storage the loss of water and dry weight is generally less in irradiated tubers than in untreated ones. With artichoke tubers both sprouting and weight loss can be considerably reduced by x-ray exposure. (auth)

12887 PROTECTION OF CELLS IN TISSUE CULTURE BY MEANS OF CYSTEAMINE AND CYSTAMINE AGAINST THE ACTION OF NITROGEN MUSTARD AND X-RAYS. Aage Juhl Therkelsen (Univ. of Aarhus, Denmark). Biochem. Pharmacol., 8: 269-79(Nov. 1961). (In English)

Studies were made of the protective effects of cystea-

mine and cystamine against x radiation and nitrogen mustard damage to cells in tissue cultures. Both cysteamine and cystamine afford good protection against nitrogen mustard (HN2), whereas under the same experimental conditions no definite protection of the cultures is obtained against x irradiation with doses of 1160, 870, 580, 290, and 145 r. The results suggest that the mechanisms of the protective action of cysteamine against x rays and nitrogen mustards are different. It is emphasized that radioprotection of isolated cells may be obtained under other experimental conditions and with other cell types. The protection obtained against nitrogen mustard supports the view that destruction of SH groups in the cell plays a central part in the biological effect of HN2. (auth)

12888 ERYTHROCYTE Fe^{59} UPTAKE AS A FUNCTION OF BONE MARROW DOSE INJECTED IN LETHALLY IRRADIATED MICE. George S. Hodgson (Oak Ridge National Lab., Tenn.). Blood, 19: 460-7(Apr. 1962).

The relation between bone marrow cell dose and 24-hour erythrocyte Fe^{59} uptake was established in lethally irradiated mice. Erythrocyte Fe^{59} uptake is a function of the dose of bone marrow cells and of the time after irradiation at which Fe^{59} is injected. By choosing appropriate bone marrow doses and times of Fe^{59} injection, the range of cell doses between 5×10^5 and 2×10^7 was explored. The relation between cell dose and Fe^{59} uptake is linear for Fe^{59} uptakes between 0 to 30%. The steepest line relating Fe^{59} uptake to cell dose is that obtained when Fe^{59} was injected at day 9 and covers the range of 5×10^4 to 5×10^5 cells. The curve obtained when iron is injected on day 5 is much flatter and covers the range of 1×10^6 to 2×10^7 cells. Erythropoiesis stimulating factor (ESF) in doses that stimulate erythrocyte Fe^{59} uptake in normal mice has no effect in irradiated, bone marrow-treated mice. Homologous marrow is slightly less effective, and rat bone marrow markedly (~100 times) less effective in promoting recovery of erythropoieis. The erythrocyte Fe^{59} uptake of mice preimmunized with homologous or rat marrow before irradiation is much lower than that of nonpreimmunized animals. (auth)

12889 EFFECT ON THE HEMATOPOIETIC TISSUES AND THE BLOOD CELLS OF SUB-TOTAL IRRADIATION IN DAILY SESSIONS REPEATED FOR A MONTH. Maurice Tubiana and Émilia Frindel (Institut Gustave Roussy, Villejuif, France). Compt. rend., 245: 183-5(Jan. 3, 1962). (In French)

Mice received each day for four weeks 150 r, with one of the posterior paws being protected. The number of leukocytes decreases during the first week, but it is then stabilized. The functional activity of the bone marrow of nonirradiated regions, at first superior to the normal, later becomes less than normal. This phenomenon is probably connected to constant migrations of cell roots of irradiated tissues to nonirradiated tissues and vice versa. (tr-auth)

12890 RADIATION-INDUCED DAMAGE IN THE ULTRASTRUCTURE OF STRIATED MUSCLE. R. M. Bergstroem and A. Salmi (Univ. of Helsinki). Exptl. Cell Research, 26: 226-8(Feb. 1962). (In English)

The first visible damage in the ultrastructure of striated frog muscle after large x irradiation doses is an irregularity of structure and vacuolization of the sarcoplasmic reticulum. (auth)

12891 FURTHER OBSERVATIONS ON THE SEX RATIO IN THE OFFSPRING OF IRRADIATED MALE BIRDS. V. Matousek, Alena Lengerová, and Marta Vojtisková (Inst. of Experimental Biology and Genetics, Czechoslovak Academy of Sciences, Prague). Folia Biol. (Prague), 8: 27-33(1962). (In English)

Four male White Leghorn chickens were irradiated with a gonad dose of 600 r. After six weeks the birds were placed in separate runs, each with 10 to 13 nonirradiated females and studies were made of the offspring. A total of 3141 chicks hatched out, 1641 of which were males. The shift in the sex ratio after irradiation of male birds was found to lie within the limits of 1.10^{-5} to 8.10^{-5} per 1 r. (C.H.)

12892 EFFECT OF LOW TEMPERATURES AND PROTECTIVE AGENTS ON RADIOSENSITIVITY OF SOME ANIMAL CELLS. V. Drašil (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 8: 34-9(1962). (In English)

Results are reported from studies on the protective effect of cysteine, AET, thiourea, and sodium thiosulfate on irradiated Ehrlich ascitic tumor and bone marrow cells. Cysteine and AET were found to protect ascitic tumor cells and bone marrow cells against the effects of ionizing radiation at temperatures of −78.4 and −192°C. Thiourea and thiosulfate gave protection at room temperature only. The results indicate that SH substances forming mixed disulfides provide protection against the direct effects of ionizing radiation even in the case of such complex systems as animal cells. (C.H.)

12893 ON THE EFFECTS OF X-IRRADIATION ON THE CHROMOSOMES OF YOSHIDA SARCOMA CELLS. (A PRELIMINARY REPORT). Takeshi Seto. Idengaku Zasshi, 35: 388-92(Dec. 1960). (In Japanese)

The Yoshida sarcoma, a rat ascites tumor, was irradiated with x rays at dosages of 500, 1000, and 1500 r, and the chromosomes were observed in tumor cells. It was found that the chromosome-number mode of tumor cells in unirradiated tumor-bearing animals occurred at 40. The chromosomes were morphologically analyzed according to the system of Tjio and Levan, and the number of chromosomes assorted in three morphological groups was 13 for M, 13 for S, and 14 for T. Breaks and translocations of chromosomes were rather common and remarkable in metaphase cells observed in irradiated tumor-animals. It was observed in individual cells that there was no constancy in the number of M, S, and T chromosomes which were unaltered by irradiation. From this result, it seems probable that there is no differential radiosensitivity by chromosomes of different types. Two chromosomes of M type are outstanding as marker elements because of their remarkably large size. In the two marker chromosomes, the frequency distribution of breakage was observed after irradiation, and showed that the breakage was rather frequent on both arms around positions one-fourth distant from the centromere. (auth)

12894 NITRIC OXIDE AS A MODIFIER OF RADIATION EFFECTS ON SHIGELLA FLEXNERI. W. M. Dale, J. V. Davies, and C. Russell (Christie Hospital, Manchester, Eng.). Intern. J. Radiation Biol., 4: 1-13 (Oct. 1961). (In English)

The mode of action of NO as a modifier of radiation sensitivity in aqueous suspensions of Shigella flexneri is different from that of O_2. NO present during irradiation has a sensitizing effect which is similar, but not chemically equivalent, to that due to O_2. Exposure to NO followed by removal of the gas prior to irradiation (i.e., pre-treatment) causes a latent irreversible effect on the bacteria, which becomes manifest after irradiation as enhanced radiation sensitivity dependent on

concentration of NO and on the time of contact. NO has also a relative protective effect. A tentative hypothesis based on the fixation of NO by unknown cell constituents is suggested. (auth)

12895 POST-IRRADIATIVE EFFECTS OF NITROGEN AND CARBON MONOXIDE ON HATCHABILITY OF HABROBRACON EGGS TREATED IN FIRST MEIOTIC METAPHASE. Leo E. LaChance (Brookhaven National Lab., Upton, N. Y.). Intern. J. Radiation Biol., 4: 15-20(Oct. 1961). (BNL-4981). (In English)

The effect of nitrogen and of carbon monoxide administered as post-radiation treatments was investigated. The hatchability of Habrobracon eggs treated in first meiotic metaphase was taken as the criterion of damage. Both gases are equally effective in enhancing the damage induced by the radiation. Since restitution is thought to be rare in irradiated metaphase oocytes, the action of these gases is considered as altering a repair mechanism which results in allowing potential damage to become actual. (auth)

12896 ELECTRON-SPIN RESONANCE STUDIES OF BOVINE-SERUM ALBUMIN AND CYSTINE IRRADIATED WITH γ-RAYS AT 77°K AND AT ROOM TEMPERATURE. D. Libby (Royal Military Coll. of Science, Shrivenham, nr. Swindon, Wiltshire, Eng.), M. G. Ormerod, A. Charlesby, and P. Alexander. Intern. J. Radiation Biol., 4: 21-6(Oct. 1961). (In English)

Previous investigations at room temperature have shown that irradiated proteins, in general, give rise to only two types of resonance pattern. One of these is asymmetric and similar to that of cystine. This similarity has led to the postulate that unpaired electrons formed within the protein migrate to the sulfur atoms of the cystine residue. It is found that the ESR spectrum obtained with BSA after irradiation in vacuum and examination at 77°K is different from that obtained on warming to room temperature. That observed on warming to room temperature is qualitatively the same as that obtained after irradiation in vacuum at room temperature, although the concentration of radicals in this latter case is greater. With cystine the ESR pattern obtained after irradiation in a vacuum and examination at 77°K is different from that obtained on warming to room temperature. This radical observed on warming to room temperature is very stable and is also produced after irradiation in vacuum at room temperature. It is unaffected by oxygen. While at room temperature the signals from cystine and BSA show some similarities, the spectra are quite different at 77°K, which reflects the primary radiation processes uncomplicated by secondary processes. The work does not support the contention that the radicals produced have a high probability of migrating to the sulfur atoms. (auth)

12897 THE EFFECT OF ELECTRON RADIATION ON THE TENSILE STRENGTH OF TENDON. Reinier Braams (Univ. of Utrecht). Intern. J. Radiation Biol., 4: 27-31(Oct. 1961). (In English)

Measurements of tensile strength were carried out on electron-irradiated strips of tendon. For dry tendon the dose needed to reduce the tensile strength to 37% of its original value was found at approximately 18 Mrad. For the hydrated tendon the 37% dose is approximately 46 Mrad. The presence of water thus reduces the sensitivity; this effect seems in disagreement with the assumption that the contributions of the direct and the indirect effect are additive. (auth)

12898 CONTRIBUTIONS TO THE STUDY OF IMMEDIATE AND EARLY X-RAY REACTIONS WITH REGARD TO CHEMOPROTECTION. IV. GASTRIC RETENTION IN RATS AFTER WHOLE-BODY IRRADIATION. H. B. Lamberts and B. G. Dijken (Univ. of Groningen, Netherlands). Intern. J. Radiation Biol., 4: 43-8(Oct. 1961). (In English)

The phenomenon of gastric retention after moderate irradiation is confirmed in rats. It is very probable that liberation of adrenaline and serotonine together is the cause of retention. (auth)

12899 A STUDY OF THE KIDNEY IN THE LAF_1 MOUSE AFTER CONTINUED DAILY GAMMA-IRRADIATION, WITH PARTICULAR REFERENCE TO PROGRESSIVE INTERCAPILLARY GLOMERULOSCLEROSIS. Paul H. Guttman (Univ. of California School of Medicine, San Francisco), Henry I. Kohn, and Samuel Lesher. Intern. J. Radiation Biol., 4: 49-59(Oct. 1961). (In English)

Beginning at 100 days of age, LAF_1 mice were exposed to 12 or 14 r per day of Co^{60} γ-rays. In the unirradiated animals, the degree of intercapillary glomerulosclerosis was relatively constant from 100 to 500 days of age, after which it progressively increased. The animals receiving 24 r per day did not survive beyond 500 days of age; their kidneys were like those of the unirradiated animals. In animals receiving 12 r per day, the degree of intercapillary glomerulosclerosis after 300 days of age was only a little greater than in the unirradiated animals, though consistently so. This was true even in 700-day-old animals that had received an accumulated dose of 6600 r. The small renal arteries and arterioles were not altered. Thus continued small daily doses of γ-radiation resulted in much less renal damage than had been found in a previous study with single doses of x rays. (auth)

12900 FURTHER STUDIES ON THE MECHANISM OF INHIBITION OF DNA-SYNTHESIS BY IONIZING RADIATION. R. J. Berry (Churchill Hospital, Oxford), Elizabeth Hell, L. G. Lajtha, and M. Ebert. Intern. J. Radiation Biol., 4: 61-6(Oct. 1961). (In English)

DNA-synthesis in vitro was studied in cells after exposure to x- or fast-neutron irradiation. The measure was the incorporation into DNA of C^{14}-thymidine by Ehrlich ascites cells and of C^{14}-thymidine or C^{14}-formate by human bone-marrow cells. The radiation response is biphasic, dependent on oxygen, and is similar for both systems. (auth)

12901 THE CATABOLISM OF TISSUE NUCLEIC ACID. III. THE CATABOLISM OF RIBONUCLEIC ACID AFTER TOTAL-BODY X-IRRADIATION. George B. Gerber, Gisela Gerber, and Kurt I. Altman (Univ. of Rochester School of Medicine and Dentistry, Rochester, N. Y.). Intern. J. Radiation Biol., 4: 67-73(Oct. 1961). (In English)

The catabolism of RNA after total-body x-irradiation of rats was studied by labelling RNA with glucose-U-C^{14}. The specific activities of urinary ribosyl imidazole acetate, as well as of RNA of liver, intestine, muscle, and spleen, were determined after x- or sham-irradiation. After exposure to 1000 r, the specific activity of urinary ribosyl imidazole acetate was increased, whereas that of intestinal and muscle RNA was decreased. The specific activity of RNA in lymphoid organs was also decreased after exposure to 756 r. It is concluded that a radiation-induced increase in RNA catabolism is present mainly on the second and third day after exposure, primarily in intestine and muscle. In contrast, the starvation-induced

increase in the catabolism of RNA occurs primarily in the liver and on the first day of starvation. (auth)

12902 THE MECHANISM OF GLYCOLYSIS INHIBITION BY X-RAYS IN ASCITES-TUMOUR CELLS. I. ALTERATION IN STEADY-STATE CONCENTRATIONS OF SOME INTERMEDIATE NUCLEOTIDES AND IN ELECTROLYTE EQUILIBRIUM UNDER VARIOUS CONDITIONS OF INCUBATION. Klaus Dose and Ursula Dose (Istituto Regina Elena per lo Studio e la Cura dei Tumori, Rome). Intern. J. Radiation Biol., 4: 85-95(Oct. 1961). (In English)

The anaerobic glycolysis of Ehrlich ascites-tumor cells is inhibited in vitro by x rays. For lower doses (25 kr) this inhibition is reversible, and an increase of triose and hexose phosphates has been found. With increasing dose (over 50 kr) the resulting inhibition becomes more irreversible, and the triose and hexose phosphate concentrations fall far below the normal values. In all cases, a dose-dependent decrease in ATP and DPN with a slightly S-shaped dose-effect curve, as well as an increase in the potassium-diffusion, was observed. The effect of irradiation on the alteration of transport equilibria, and the corresponding decrease of $Q_{LA}^{N_a}$ values, can be greatly reduced if metabolism is increased by adding inorganic phosphate, ATP and ADP. However, the relative alterations in triose and hexose phosphates, ATP, and DPN concentractions caused by x irradiation remain largely unchanged by this increase. With increasing x-ray doses, phosphate-splitting enzymes are activated. A large part of DPN is already radiation-chemically destroyed. (auth)

12903 SOME DELAYED EFFECTS OF PARTIAL-BODY IRRADIATION IN MICE OF THE RF STRAIN. G. E. Cosgrove and A. C. Upton (Oak Ridge National Lab., Tenn.). Intern. J. Radiation Biol., 4: 97-103(Oct. 1961). (In English)

The effects of partial-body irradiation on life-span and incidence of disease were studied in young adult female RF mice treated as follows: 100 r x rays to whole-body, 300 r x rays to whole-body, 300 r x rays to upper third of body, 300 r x rays to middle third of body, 300 r x rays to lower third of body, and non-irradiated controls. The mean survival-times of the aforementioned groups were 17.8, 15.2, 18.7, 18.6, 18.4, and 19.2 months, respectively. The incidence of thymic lymphoma was 25, 30, 11, 14, 19, and 19%, and of myeloid leukaemia, 5, 15, 3, 3, 4, and 5%. Partial-body irradiation induced lens opacities and ovarian tumors, but only when the lens and ovaries, respectively, were exposed. (auth)

12904 FURTHER STUDIES ON THE INFLUENCE OF OXYGEN ON X-RAY-INDUCED REARRANGEMENT IN DROSOPHILA OOCYTES. Seymour Abrahamson (Rutgers Univ., Newark, N. J.). Intern. J. Radiation Biol., 4: 113-25 (Nov. 1961). (In English)

Alteration of the metabolism of Drosophila oocytes greatly affects the induction of structural changes by x rays. Females 2 to 3 days of age contain oocytes whose chromosomes restitute and rearrange rapidly, whereas no evidence for restitution within the intervals studied was found in samples of oocytes from females 8 to 9 days old at the time of irradiation. The effect of nitrogen as a post- or inter-treatment showed, however, that for both young and old oocytes there was more restitution in air than in nitrogen. Both young and old oocytes show reduced rearrangement frequencies when irradiations were performed in nitrogen, and increased rearrangement frequencies when a fractionated irradiation was performed with the flies maintained in a nitrogen environment between irradiations. These different effects of anoxia are discussed. (auth)

12905 STUDIES ON CELL-SURVIVAL OF IRRADIATED EHRLICH ASCITES TUMOUR. I. THE EFFECT OF THE HOST'S AGE AND THE PRESENCE OF NON-VIABLE CELLS ON TUMOUR TAKES. G. Silini and S. Hornsey (Hammersmith Hospital, London). Intern. J. Radiation Biol., 4: 127-34(Nov. 1961). (In English)

An average inoculum of as little as 1 to 4 cells of a tetraploid Ehrlich ascites tumor has been found sufficient to give rise to 50% tumor takes in new-born mice. The number of inoculated cells necessary to produce a tumor increases rapidly with the age of the host mice. The viability of the tumor cells did not appear to be affected when they were inoculated in a mixture with heavily-irradiated tumor cells. (auth)

12906 STUDIES ON CELL-SURVIVAL OF IRRADIATED EHRLICH ASCITES TUMOUR. II. DOSE-EFFECT CURVES FOR X-RAY AND NEUTRON IRRADIATIONS. S. Hornsey and G. Silini (Hammersmith Hospital, London). Intern. J. Radiation Biol., 4: 135-41(Nov. 1961). (In English)

Survival-curves were obtained for a tetraploid Ehrlich ascites tumor after irradiation with 200 kv x rays and with fast neutrons in the presence or absence of oxygen. The oxygen-enhancement ratio for 200 kv x rays was found to be 3.1 and for fast neutrons 1.8. The RBE of fast neutrons relative to 200 kv x rays was found to be 2.1 in oxygen and 3.6 in nitrogen. These results have been discussed with reference to similar results obtained on telophase abnormality studies in the same tumor. (auth)

12907 THE RESISTANCE OF ANIMALS TO ACUTE COLD EXPOSURE FOLLOWING X-IRRADIATION. B. D. Newsom and D. J. Kimeldorf (Naval Radiological Defense Lab., San Francisco). Intern. J. Radiation Biol., 4: 143-9 (Nov. 1961). (In English)

The resistance of rats and guinea-pigs to acute exposures of severe cold (−20°C) is lowered following irradiation. The resistance to cold of rats varied inversely with radiation dose, and the effect was present on the first day after sub-lethal doses of x rays. After sub-lethal irradiation (400 r), the altered resistance persisted through the eighteenth day and then disappeared. After an LD_{50}-exposure to x rays, the surviving rats exhibited a lowered resistance to cold at six months after irradiation. (auth)

12908 URINARY EXCRETION OF 5-HYDROXYINDOLACETIC ACID AFTER A SINGLE WHOLE-BODY X-IRRADIATION IN NORMAL AND ADRENALECTOMIZED RATS. M. Randić and Z. Supek (Institute 'Ruder Bŏsković' Zagreb). Intern. J. Radiation Biol., 4: 151-3(Nov. 1961). (In English)

The urinary excretion of 5-hydroxyindoleacetic acid after whole-body x irradiation (800 r) in normal and adrenalectomized rats was studied. After x irradiation a significant but transient increase of 5-hydroxyindoleacetic acid in urine in both groups of animals was found. The results obtained are discussed. (auth)

12909 COMPETENCE OF RETRANSPLANTED HOMOLOGOUS MARROW CELLS IN RELATION TO TIME AFTER ORIGINAL TRANSPLANTATION INTO IRRADIATED MICE. Raymond A. Popp (Oak Ridge National Lab., Tenn.). Intern. J. Radiation Biol., 4: 155-61(Nov. 1961). (In English)

C57BL and 101 parental bone-marrow cells, grown for different periods of time in irradiated (C57BL × 101) F_1 recipients, were retransplanted into secondary F_1 recipients in an attempt to evaluate the competence of the re-

grafted marrow. When either type of parental bone-marrow was allowed to grow in primary recipients for less than 30 days and subsequently transplanted into secondary recipients, the survival of secondary recipients was inferior to that of primary recipients. However, when parental bone-marrow remained in primary recipients more than 30 days, the survival of secondary recipients was superior to that of primary recipients. These effects may be ascribed to alterations of the immunological competence of the donor-marrow rather than to its failure to take or to its rejection, since the functional hematopoietic cells in all secondary recipients were principally of donor-type as judged by red-cell markers; i.e. sensitization of the marrow may have been exhibited when it was retransplanted early, but immunological paralysis, exhaustion, or partial tolerance was manifested when it was retransplanted after periods of 30 days or longer. (auth)

12910 RADIOSENSITIVITY OF THE CORTICAL AND MEDULLARY LYMPHOCYTES IN THE THYMUS. O. A. Trowell (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). Intern. J. Radiation Biol., 4: 163-73(Nov. 1961). (In English)

Rats were sacrificed 48 hrs after x irradiation of the thymic region and differential cell-counts were made on sections to determine the lymphocyte reticulum-cell ratio in cortex and medulla. Assuming the reticulum cells unaffected, the decrease in the ratio compared with controls gave the decrease in lymphocyte population. It is argued that the results mainly represent direct lymphocyte killing. In the cortex, percentage survival was a linear function of log dose. But in the medulla this relationship only held above 100 r; after lower doses the percentage remaining was unexpectedly high, probably because lymphocytes had migrated from cortex to medulla. The cortical lymphocytes were four times more sensitive than the medullary, and the radiosensitivity boundary was shown to be sharp. It is suggested that lymphocytes may be partially protected by reticulum cells, possibly by transfer of ATP. (auth)

12911 SPONTANEOUS AND X-RAY-INDUCED SOMATIC-CHROMOSOME ABERRATIONS IN THE CHINESE HAMSTER. M. A. Bender and P. C. Gooch (Oak Ridge National Lab., Tenn.). Intern. J. Radiation Biol., 4: 175-84(Nov. 1961). (In English)

The spontaneous and induced chromosome-aberration rates in the bone-marrow of the Chinese hamster, Cricetulus griseus, have been investigated. The spontaneous aberration rate is so low that no aberrations have yet been seen in control material. Two hours after irradiation the induced aberration rate was 0.0051 breaks per cell per r. The aberration rate fell rapidly with time after irradiation. Aberrations of all the expected types were found, but two-hit aberrations did not appear until the sixth hour. The results support the conclusion that epithelioid cells in vitro have about the same sensitivity as a rapidly-dividing tissue in vivo, while fibroblasts are much more sensitive. (auth)

12912 THE EVALUATION OF X-RAY-INDUCED CHROMOSOME ABERRATIONS IN CELL-CULTURES OF THE CHINESE HAMSTER. Charles L. Greenblatt (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Intern. J. Radiation Biol., 4: 185-210(Nov. 1961). (In English)

The sources of variation in the evaluation of x-ray-induced chromosome aberrations in cell cultures of Chinese hamster (Cricetulus griseus) are discussed. The most important of these, in determining the nature and number of the lesions, seems to be the time of observation in relation to the growth of the cells. The number of visibly damaged mitoses in the first generation after irradiation in cells in metaphase and anaphase is consistent with the number of cells incapable of proliferation. From calculations of the number of chromosome aberrations occurring in these cells and their survival-curve, a working hypothesis is proposed which seems consistent with many features of cellular death due to radiation. (auth)

12913 THE EFFECTS OF WHOLE-BODY IRRADIATION ON THE REPRODUCTIVE RHYTHM OF THE AVIAN TESTIS. B. Lofts and J. Rotblat (St. Bartholomew's Hospital Medical Coll., London). Intern. J. Radiation Biol., 4: 217-30(Jan. 1962). (In English)

Groups of male birds (Quelea quelea) were subjected to a single whole-body exposure of 15-Mev x rays at doses of 50 r, 210 r, 420 r, 630 r, 840 r, and 1040 r respectively. In all dose groups irradiation resulted in a premature testis metamorphosis involving a sudden decrease in size and the genesis of large quantities of cholesterol-positive lipid within the seminiferous tubules. This phenomenon is apparently identical with that occurring annually in wild birds at the end of the breeding season. The possibility that this has been induced as a result of pituitary stimulation is discussed. No apparent testicular damage was sustained by the 50 r and 210 r groups, and specimens underwent a normal revival of spermatogenesis during the succeeding breeding season. In the higher radiation groups, however, many birds were unable to produce germ cells more mature than primary spermatocytes, and the testis displayed an abnormal histological condition. The LD_{50} at 30 days was found to be 1060 ± 100 r, and the median survival-time about 17 days. (auth)

12914 PROTECTIVE EFFECTIVENESS OF CYSTAMINE VERSUS DELAY OF EXPOSURE, BODY TEMPERATURE AND PROTEIN LINKAGE. E. H. Betz, D. J. Mewissen, and P. Lelievre (Université, Liège). Intern. J. Radiation Biol., 4: 231-8(Jan. 1962). (In English)

In rats which received an intraperitoneal injection of cystamine, the protective effectiveness against whole-body irradiation reached a maximum 10 min after administration. No correlation existed between the total amount of cystamine detected in different tissues at various time-intervals after injection and the degree of protection afforded. Neither was there any parallelism between the time variations of protective effectiveness and the amount of free or protein-bound cystamine in the tissues. (auth)

12915 THE RELATIVE BIOLOGICAL EFFICIENCY OF FAST NEUTRONS AND GAMMA-RAYS FOR LIFE-SHORTENING IN CHRONICALLY IRRADIATED CBA MICE. G. J. Neary, E. V. Hulse, and R. H. Mole (Medical Research Council Radiobiological Research Unit., Harwell, Berks, Eng.). Intern. J. Radiation Biol., 4: 239-48(Jan. 1962). (In English)

CBA mice have been irradiated from early maturity to death with low daily doses of fast neutrons or gamma-radiation delivered nearly continuously. For life-shortening the rbe of the fast neutrons was about 10 for mice of either sex; there was no significant dependence on size of daily dose within the range investigated. (auth)

12916 CONTRIBUTIONS TO THE STUDY OF IMMEDIATE AND EARLY X-RAY REACTIONS WITH REGARD TO CHEMOPROTECTION. V. LIBERATION OF SEROTONIN (AND OTHER AMINES) IN THE FROG AFTER X-IRRADIATION. R. Brinkman and T. S. Veninga (State Univ., Groningen, Netherlands). Intern. J. Radiation Biol., 4: 249-54(Jan. 1962). (In English)

It is shown that in hypophysectomized frogs the aggregated melanophore pigment will expand in response to moderate total-body x-irradiation. The effect is shown to be mediated by the liberation of neurohormones, and serotonin is indicated specially. The methods were partial shielding, paper chromatography of the renal excretion on serotonin after x-irradiation, and reflection photometry of small pieces of frog's skin. (auth)

12917 RADIOBIOLOGICAL STUDY ON VICIA FABA SEEDS. THE INFLUENCE OF WATER CONTENT, OXYGEN SUPPLY, AND STORAGE PERIOD ON PRIMARY AND SECONDARY RADIATION EFFECTS. Walter Klingmueller (Universität, Gissen, Ger.). Intern. J. Radiation Biol., 4: 255-76(Jan. 1962). (In German)

Electron spin resonance measurements on Vicia faba seed showed that in the seed coat higher concentrations of free radicals are induced by x rays than in the embryo. Free radicals were also induced by drying and illumination. Growth measurements on plants from irradiated seeds showed that in dry seeds x-ray damage is light-dependent. Seeds soaked immediately after the end of irradiation and grown in the light produced plants in which the relative shoot and root growth differed from dark-grown plants. After effects of radiation damage were also found to be dependent on lighting conditions. (C.H.)

12918 EFFECTS OF LOCAL ROENTGEN IRRADIATION ON THE RATE OF ENDOGENOUS-DEHYDROGENASE ACTIVITY IN THE EPIDERMIS OF HAIRLESS MICE STUDIED BY MEANS OF A TETRAZOLIUM-REDUCTION METHOD. O. H. Iversen and F. Devik (Institutt for Generell og Eksperimentell Patologi, Rikshospitalet, Oslo). Intern. J. Radiation Biol., 4: 277-83(Jan. 1962). (In English)

Four-hundred-and-forty-one mice from a recessive hairless strain were given local roentgen irradiation on a skin-flap with doses from 2700 to 500 r. The amount of formazan deposited in the epidermis was measured at different time-intervals after irradiation, and the results presented as the ratio between the values obtained in irradiated and non-irradiated areas. A characteristic reaction was observed with an increase in the deposition of formazan, followed by a period of decrease. The effect was decreasing with falling doses and hardly measurable with 500 r. The findings are interpreted as pointing to some destruction of the cellular respiration. The similarity between this effect and the effect of chemical carcinogens is briefly mentioned. (auth)

12919 EFFECTS OF IONIZING RADIATIONS ON L- AND DL-TYROSINE STUDIED BY ULTRA-VIOLET AND INFRA-RED SPECTROPHOTOMETRY. R. B. Donde and K. S. Korgaonkar (Indian Cancer Research Centre, Bombay). Intern. J. Radiation Biol., 4: 285-97(Jan. 1962). (In English)

Solutions of L- and DL-varieties of tyrosine were irradiated by γ-rays from Co^{60}, and samples of L-tyrosine by β, γ-radiations from radon glass capillaries. Marked changes in both ultra-violet and infra-red spectra were observed. L- and DL- varieties irradiated with Co^{60} γ-radiations do not show significant differences in radiation sensitivity; both gave G-values ≈ 3. Greater radiosensitivity toward β-rays is indicated in the results. The evidence presented for radiation effect suggests deamination, formation of intermediary compounds with increased OH attachment to the benzene nucleus, and compounds with C–O–C in the ring among the end-products. Probable mechanisms are discussed. (auth)

12920 AN IMMEDIATE DOSE-DEPENDENT METABOLIC EFFECT OF ULTRA-VIOLET IRRADIATION. Elsie Wainfan and Ernest Borek (Columbia Univ., New York). Intern. J. Radiation Biol., 4: 327-9(Jan. 1962). (In English)

The inhibition of formate metabolism was found to be exponentially dose-dependent in Escherichia coli exposed to ultraviolet radiation. Data are presented graphically and results are discussed. (C.H.)

12921 ELECTRON MICROSCOPY OF CELLULAR DIVISION IN ESCHERICHIA COLI. S. F. Conti and M. E. Gettner (Brookhaven National Lab., Upton, N. Y.). J. Bacteriol., 83: 544-50(Mar. 1962).

Exponentially growing cells of Escherichia coli were fixed in formalin, exposed to uranyl nitrate, dehydrated at low temperatures with ethanol, and embedded in methacrylate. Polymerization was carried out at −70°C, by exposure of specimens to radiation from a Co^{60} source. Electron micrographs revealed that cellular division occurs by the centripetal growth of the cell wall. The fine structure of the cytoplasm, nuclear apparatus, cell wall, and cytoplasmic membrane was also studied. (auth)

12922 TRANSDUCTION BY ULTRAVIOLET-IRRADIATED VIRULENT BACTERIOPHAGE. Eugene P. Goldschmidt and Otto E. Landman (Army Chemical Corps, Fort Detrick, Frederick, Md.). J. Bacteriol., 83: 690-1(Mar. 1962).

Transduction of Salmonella typhimurium LT-2 recipients by temperate or virulent strains of phage PLT-22 was performed, and the transducted colonies were counted after 2 days of incubation at 37°C. The transduction frequencies obtained with the virulent mutant phages were markedly dependent on ultraviolet dosage. The maximal transduction frequency was obtained when the plaque titer was reduced to 10^{-7} with an ultraviolet dosage of 6000 ergs/mm^2. Transduction could not be demonstrated with ultraviolet irradiated virulent phages unrelated to known transducing phage. (P.C.H.)

12923 THE EFFECT OF N-ETHYLMALEIMIDE ON THE RADIATION SENSITIVITY OF BACTERIA. B. A. Bridges (Wantage Research Lab., Berks, Eng.). J. Gen. Microbiol., 26: 467-72(1961).

The sensitization of Escherichia coli strain B/r to γ radiation was shown to take place within a few minutes of the addition of N-ethylmaleimide. Sensitization was demonstrated with as little as 0.0001 M-N-ethylmaleimide, but a much higher concentration (>0.002 M) was necessary for any bactericidal effect. The N-ethylmaleimide had to be present during irradiation in order to be effective. Staphylococcus aureus and a Pseudomonas sp. but not spores of Bacillus subtilis, were also sensitized by N-ethylmaleimide. The Pseudomonas sp. was only sensitized under anoxic conditions; this may indicate that, with this organism, N-ethylmaleimide and oxygen acted competitively in enhancing radiation damage. Possible mechanisms of sensitization are discussed. (auth)

12924 HISTOPATHOLOGICAL STUDIES ON THE EFFECT OF IRRADIATION WITH VARIOUS DOSES OF X-RAYS UPON THE HEMOPOIETIC TISSUE OF YOUNG MICE. I. CHANGES IN LYMPHATIC TISSUE. Isamu Takahashi, Kaoru Sakaki, Kiyoshi Hirasawa, and Kyoichi Tanaka. Natl. Inst. Animal Health Quart. (Tokyo), 1: 157-69(Fall 1961).

Irradiation with 60 r caused slight but conspicuous damage in the lymph nodes and the white pulp of the spleen of young mice. With the increase in the dose of irradiation, damage, including degeneration, destruction, and reduction

in number of lymphocytes, became more distinct. After the irradiation with a dose not less than 180 r, the nodules of the lymph node showed atrophy and loosening in structure and were sometimes reduced to a rudimentary state. The white pulp of the spleen revealed changes similar to, but a little slighter than, those mentioned above, containing still not a small number of normal lymphocytes. In the case of irradiation with 600 r, extreme aplasia was observed in the white pulp of the spleen as well as in the lymph node. Even in this case, however, the white pulp of the spleen scarcely disappeared. The process of damage mentioned above was so rapid that it reached its peak 24 hours to two days after irradiation in all animals of each group. The process of regeneration of the lymphatic tissue varied according to the dose of irradiation. In the process of regeneration, there was a distinct difference of reconstitution between the lymph node and the white pulp of the spleen, especially when they had been exposed to irradiation with a dose not less than 300 r. In such a case, the lymph node was frequently seen to be devoid of nodules from the beginning to the middle stage of regeneration, when proliferation of lymphocytes was mainly carried out in the lymphatic tissue of the cortex. On the other hand, the white pulp of the spleen retained clearly most nodules, from which regeneration was started. (auth)

12925 RECOVERY EFFECT OF HIGHLY POLYMERIZED HOMOLOGOUS LIVER DEOXYRIBONUCLEIC ACID INJECTED INTO LETHALLY IRRADIATED RATS: HISTOLOGICAL EXAMINATION OF THE DIGESTIVE ORGANS. V. Pantić (Univ. of Belgrade), N. Stošić, D. Kanazir, A. Bećarević, and G. Jovicki. Nature, 193: 993-4(Mar. 10, 1962).

It has been found that x-irradiated rats treated with highly polymerized nucleic acids survive lethal doses. Observations are reported on the structure alterations in certain regions of the fundus ventriculi, small and large intestines, and liver for lethally irradiated rats as compared with rats lethally irradiated but treated with desoxyribonucleic acid (DNA). Histological examinations of the organs were carried out on rats killed 4 and 9 days after x irradiation. In all cases, the structure was less altered for the DNA-treated rats. (D.L.C.)

12926 X-RADIATION INHIBITION OF THE INDUCTION OF KIDNEY ENZYMES CATALYSING SYNTHESIS OF DEOSYRIBONUCLEIC ACID IN VITRO. R. K. Main, L. J. Cole, and E. R. Walwick (Naval Radiological Defense Lab., San Francisco). Nature, 193: 995-6(Mar. 10, 1962).

Female rats 3.5 weeks of age were given single whole-body lethal doses of 850 rad x rays. Groups of these rats were subjected to left unilateral nephrectomy at 15 min to 7 days post-irradiation, and the remaining (right) kidney was extirpated upon killing each animal 48 hr post-nephrectomy. Non-irradiated rats receiving similar surgical treatment were used as controls. The kidneys were homogenized and centrifuged and the supernate used as an enzyme source. The specific activity of the enzymes was determined by measuring the incorporation of tritiated thymidine into the synthesized desoxyribonucleic acid (DNA), and the data are presented as the ratio of the activity of the right kidney to that of the left kidney and called the induction ratio. For the controls, unilateral nephrectomy resulted in an average induction ratio of 16.6, while irradiation reduced the induction ratio to as low as 0.27. The results indicate that x irradiation causes latent injury to a system responsible for the induction of kidney enzymes required for DNA synthesis when the radiation is applied before induction. (D.L.C.)

12927 EFFECT OF LETHALLY IRRADIATED CELLS ON THE DEVELOPMENT OF NEW-BORN RATS. Miroš Klímek (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Nature, 193: 996-7(Mar. 10, 1962).

The effects of heterotransplantation of irradiated hyperdiploid (E/Dipl) and hypotetraploid (E/Sto) variants of Ehrlich's ascites tumor on the development of 1- and 2-days-old rats were studied. The cells were given a lethal dose of 12,000 r x radiation and injected intraperitoneally into the mice, and the body weight and length of the mice were followed for times up to 24 days after injection and compared with controls. The rats injected with E/Sto cells began to show a marked growth retardation after 6 to 9 days, while E/Dipl cells showed almost no growth retardation. The difference in the effect of E/Dipl and E/Sto cells may be due to the higher radioresistance of E/Sto cells. No tumor growth resulted. (D.L.C.)

12928 CALCIUM AND ITS RELATIONSHIP TO RADIOSENSITIVITY AND CANCER. A. Elkeles (Prince of Wales's General Hospital, London). Nature, 193: 1089 (Mar. 17, 1962).

Radiosensitivity and cancer studies on animals and human beings are discussed briefly with respect to the relationship of calcium to radiosensitivity and cancer. A hypothesis is proposed that calcium in the chromosomes is a stabilizing factor against both radiation effects and carcinogenic agents. (D.L.C.)

12929 REDUCTION OF THE PATHOGENICITY OF FASCIOLA HEPATICA IN MICE BY X-IRRADIATION. D. L. Hughes (Allen and Hanburys, Ltd., Ware, Herts, Eng.). Nature, 193: 1093-4(Mar. 17, 1962).

It was found that x irradiation of metacercarie reduced their pathogenicity so that infected mice do not die 3 to 4 weeks after infection as they would do if infected with normal metacercarie. X irradiation levels of 4 to 100 kr were sufficient to cause the effect. Examination was carried out on the body cavity and thorax after infection with irradiated metacercarie; living immature flukes were found in the liver, but they were stunted and died 18 to 28 days after irradiation. (D.L.C.)

12930 DOSE-SURVIVAL CURVES OF HUMAN CELLS IN TISSUE CULTURE IRRADIATED WITH ALPHA-, BETA-, 20-KV. X- AND 200-KV. X-RADIATION. G. W. Barendsen (Radiobiological Inst., National Health Research Council, TNO, Rijswijk, Netherlands). Nature, 193: 1153-5(Mar. 24, 1962).

The inhibition of clone formation was measured after irradiation of kidney cells of human origin (T-cells) with α rays from Po^{210}, β rays from Y^{90}, and 20 and 200 kv x rays. The surviving fraction of cells irradiated with α particles decreased exponentially with dose. An initial slope of the 200 kv curve at low doses corresponded to an LD_{37} of 450 ± 100 rads, as calculated from survival percentages of 94.3 ± 2.3 and 89.7 ± 2.1 at doses of 25 and 50 rads, respectively. The slope further increased continuously with the dose and corresponded to an LD_{37} of 180 rads at a dose of 700 rads and to an LD_{37} of about 110 rads at a dose of 1400 rads. Results indicate that there is no straight-line portion at higher doses in the survival curve obtained with 200 kv x radiation. The shape of the survival curves has consequences for the interpretation of the recovery of sub-lethal damage. By fractionation of 200 kv x radiation doses, the surviving fraction of cells is increased if the interval is sufficiently large. With α radiation, however, no differences due to fractionation were detected. This suggests that the single event part of the damage produced by sparsely ionizing radiation cannot be repaired. (P.C.H.)

12931 POLLEN RADIOBOTANY. J. L. Brewbaker and G. C. Emery (Brookhaven National Lab., Upton, N. Y.). Radiation Botany, 1: 101-54(Jan. 1962). (BNL-5707). (In English)

Discussion is given on the botany of angiosperm pollen, effects of pollen irradiation on pollen germination and tube growth, cytological aberrations observed at pollen-tube mitosis, endosperm marker losses in maize, production and viability of seeds, and cytological and genetic effects in F_1 and advanced families. A résumé of the comparative effects of ultraviolet and x irradiations is also given. Special attention is given to the effects of irradiation on mature angio-sperm pollen grains. 188 references are included. (P.C.H.)

12932 RADIATION GENETICS IN WHEAT. VII. COMPARISON OF RADIATION EFFECTS OF BETA- AND GAMMA-RAYS ON DIPLOID WHEAT. S. Matsumura (National Inst. of Genetics, Misima, Japan). Radiation Botany, 1: 155-64(Jan. 1962). (In English)

Seeds of Triticum monococcum flavescens were soaked in P^{32} and I^{131} solutions for 2 days before sowing, to compare the effects of beta and gamma radiations. Radioactive solutions of pH 6-7 contained 0.05-0.8 mc/gr P^{32} and 0.2-0.8 mc/g I^{131}. For comparison, seeds soaked in water for 2 days were exposed to gamma radiation with Co^{60} at the dosages 2.5, 5, 10, and 20 kr. The growth of seedlings, height of mature plants, single-spike fertility, and chromosome aberrations of treated plants in X_1 and chlorophyll mutations in X_2 were compared for beta and gamma irradiation. The higher the dosage of beta and gamma rays, the more delayed were emergence and growth of seedlings and the lower were survival rate, height of mature plants, and fertility. The relation between the inhibition of seedling growth and dosage of beta and gamma radiations coincides roughly with that between the decrease of survival rate or fertility and dosage. There was no emergence of seedlings at 20 kr gamma radiation and 0.8 mc/g P^{32} beta radiation. The effects of beta radiation from 0.15-0.2 mc/g P^{32} and 0.8 mc/g I^{131} solutions correspond roughly to those of 2.5 kr gamma radiation. As to chromosome aberrations and chlorophyll mutations, the effects of 2.5 kr gamma radiation coincide roughly with those of 0.1 mc/g P^{32} and 0.6-0.8 mc/g I^{131} solution. If it is assumed that the effects of beta radiation are confined only to the embryo, then a 0.2 mc/g P^{32} solution equals about 2.4 krad. This will account for the present data. (auth)

12933 CHROMOSOME ABERRATIONS, CHANGES IN DNA CONTENT AND FREQUENCY AND SPECTRUM OF MUTATIONS INDUCED BY X-RAYS AND NEUTRONS IN POLYPLOIDS. S. Bhaskaran and M. S. Swaminathan (Indian Agricultural Research Inst., New Delhi). Radiation Botany, 1: 166-81(Jan. 1962). (In English)

A study of the relation between polyploidy and radiosensitivity was carried out in diploid, tetraploid, and hexaploid species of wheat and in diploid and autotetraploid barley using x rays and fast and thermal neutrons. Survival, frequency of chromosome aberrations, DNA content of nuclei, seed fertility, and frequency of mutations in the second and third generations were used as indexes of radiosensitivity. Survival was better in 4x barley in comparison with the diploid in x-ray treatments, while an increase in radiation resistance with an increase in chromosome number was evident in the wheat series with fast neutrons. Data on the frequency of chromosome aberrations and reduction in DNA content observed in root-tip nuclei indicated a possible interaction between polyploidy and the LET of the radiation employed. Seed fertility was less affected in polyploids than in diploids. The frequency of chlorophyll mutations decreased with increasing ploidy in both wheat and barley while the frequency of viable mutations registered the opposite trend in wheat. Recessive mutations could be detected in 4x barley only in the M_3 generation. The relative proportion of chlorophyll and morphological mutations observed in 4x barley during the M_3 generation was similar to that found in 6x wheat in M_2 and M_3 generations. Though a high frequency of viable mutations was observed in 6x wheat, the spectrum of the induced variation was very narrow, thereby indicating that this species is a functional diploid only for a few loci. (auth)

12934 RECOVERY OF THE LAND PLANTS AT ENIWETOK ATOLL FOLLOWING A NUCLEAR DETONATION. R. F. Palumbo (Univ. of Washington, Seattle). Radiation Botany, 1: 182-9(Jan. 1962). (In English)

A long-term investigation was conducted at Eniwetok Atoll during 1954-57 to determine the rate of recovery of land plants damaged by the radiation, shock, and heat blast of the Nectar detonation in 1954. At Belle Island seven plant species were tagged, measured, and photographed before the detonation. At approximately monthly intervals after the detonation for a period of ten months, and again after an interval of six months, the plants were observed and photographed. The first indication of recovery was observed on the eighth day, at which time buds were noticeable on stems of Scaevola and Messerschmidia plants. In a month's time, most of the plants had formed new leaves and some had produced flowers and fruits. In six months, the general condition of the vegetation was similar to that which existed before the detonation. Two plants, Guettarda and Portulaca, which were unhealthy at ten months, had improved by the sixteenth month. Photographs of the recovery of some of the plants are included, as well as a discussion of agents other than radiation which have been reported to cause similar damage to plants of the coral atolls of the Pacific Ocean. (auth)

12935 THE NATURE OF RADIATION HAZARDS AND PRECAUTIONS AGAINST THEM. Roy. Soc. Health J., 80: No. 4, (p.?) (July-Aug. 1960).

The biological effects of radiation are reviewed from the standpoint of protection of personnel engaged in work with atomic energy. The genetic effects, somatic effects, especially the increased incidence in leukemia resulting from radiation exposure, and the hazards from the ingestion, inhalation and skin contamination by radioactive materials are discussed. Genetic hazards to the population from man-made radiation are considered. The importance of the film badge is stressed for determining the weekly dose of each occupationally exposed worker. The film badge should be supplemented by quartz fiber electrometers for short-term measurements of radiation dose. The importance of constant vigilance in accident prevention and continuous monitoring of the air, gases, and liquid effluents from atomic energy plants is also stressed. (C.H.)

12936 BIOLOGICAL IRRADIATION FACILITY. Willard H. McCorkle and Harry S. Cern (to U. S. Atomic Energy Commission). U. S. Patent 3,031,394. Apr. 24, 1962.

A facility for irradiating biological specimens with neutrons is described. It includes a reactor wherein the core is off center in a reflector. A high-exposure room is located outside the reactor on the side nearest the core while a low-exposure room is located on the opposite side. Means for converting thermal neutrons to fast neutrons are movably disposed between the reactor core and the high and low-exposure rooms. (AEC)

Radiation Sickness

12937 (JPRS-12712) CONTROL MECHANISMS IN RADIATION SICKNESS. V. P. Efroimson. Translated from Problemy Kibernetiki, No. 6, 183-205(1961). 31p.

The genetic theory of radiation sickness is reviewed. Injury to cell nuclei as the primary cause of radiation sickness and the role of mutagenesis in radiation injury are discussed. The genetic theory is supported by the dominant role of chromosome rearrangements in radiation injury to cells, the presence of intracellular nonspecific mechanisms of protection of the nucleus from radiation injury as a cause of radioresistance of bacteria, protozoa, and plants, the clinical aspects of radiation injury as evidence of its mutational nature, the therapeutic activity of donor hemopoietic cells as evidence of the role of injured cells in the radiation syndrome, the role of reserves of recombinable DNA fragments in mitotic activity of embryo cells as a phenomenon explaining the significance of DNA produced by bone marrow, and the effect of DNA on postradiation separation. Some methods of prophylaxis and therapy of radiation injury are considered in relation to the biological and biochemical theory of activity of DNA fragments. (79 references). (C.H.)

12938 MECHANISM OF THE PROTECTIVE ACTION OF 2-MERCAPTOETHYLGUANIDINE (MEG) AGAINST WHOLE-BODY RADIATION IN MICE. Michael P. Dacquisto, William E. Rothe, and Edward W. Blackburn (Walter Reed Army Inst. of Research, Washington, D. C.). Intern. J. Radiation Biol., 4: 33-42(Oct. 1961). (In English)

Two-mercaptoethylguanidine will protect mice against the lethal effects of an x-ray exposure of 900 r, converting an LD_{100} in 13 days to an LD_{10} in 30 days. Body-weight, spleen, thymus, and small-intestine weight, total white-cell count and total marrow count (right femur) are identical for at least the first 48 hours post-exposure in mice given 900 r, whether treated with MEG or not. Of the parameters studied only the marrow count and small-intestine weight show definite recovery by the fifth day in MEG-treated mice; all others recover during the second post-exposure week. The evidence presented indicates that MEG-treated mice recover faster without lessening the initial damage due to radiation. A dose-reduction of about 2 was found, based on the known 30-day lethality of this strain of mouse. (auth)

12939 A STUDY ON THE MECHANISM OF RADIATION PROTECTION BY 5-HYDROXYTRYPTAMINE AND TRYPTAMINE. C. van der Meer and D. W. van Bekkum (National Defence Research Council T.N.O., Rijswijk, Netherlands). Intern. J. Radiation Biol., 4: 105-10(Oct. 1961). (In English)

Five-hydroxytryptamine (5-HT) is a powerful prophylactic against radiation in CBA mice; tryptamine is much less active. Protective doses of both compounds reduce the oxygen tension in the spleen of mice considerably. This hypoxia in the spleen is accompanied by a notable fall in blood pressure, but for 5-HT the time courses of these effects are different. It is concluded that 5-HT and tryptamine protect mice against radiation by lowering the oxygen tension in the blood-forming organs. (auth)

12940 RADIOPROTECTIVE ACTION OF SOME INDOLEALKYLAMINES. Ž. P. Supek, M. Randić, and Z. Lovašen (Institute 'Rudjer Boskovic', Zagreb). Intern. J. Radiation Biol., 4: 111-12(Oct. 1961). (In English)

The radioprotective action of 5-methoxytryptamine was found to be greater than that of 5-hydroxytryptamine in rats. Preliminary experiments in mice showed a protective action similar to that in rats. No protective effect was shown for psilocybine, a potent vasoconstrictor. It was concluded that no parallelism between vasoconstriction and radioprotection exists. (C.H.)

12941 ON THE MECHANISM OF THE RADIOPROTECTIVE ACTION OF CYANIDE. C. Van der Meer (National Defence Research Organization T.N.O., Rijswijk, Netherlands), O. Brocades Zaalberg, O. Vos, A. J. Vergroesen, and D. W. van Bekkum. Intern. J. Radiation Biol., 4: 311-19(Jan. 1962). (In English)

The mechanism of the radioprotective action of cyanide was investigated with rat-thymocyte suspensions, cultured human-kidney cells, and with mice. Cyanide does not protect cells in vitro. In the thymocyte system, cyanide has instead a slight radiosensitizing action. The presence of cyanide after the irradiation causes an inhibition of the development of eosin permeability. In mice, cyanide produces a hypoxia of the spleen and bone-marrow. This hypoxia explains the protection against a lethal dose of x rays. (auth)

12942 ACUTE RADIATION SYNDROME CAUSED BY ACCIDENTAL EXPOSURE TO COBALT. Ennio C. Rossi, Alice A. Thorngate, and Frank C. Larson (Univ. of Wisconsin Medical School, Madison). J. Lab. Clin. Med., 59: 655-66(Apr. 1962).

A case of acute radiation syndrome due to accidental exposure to Co^{60} is presented. Based on physical considerations, the dose received was estimated to be between 250 to 300 r. The clinical picture corresponded closely to that of the hematologic form of acute radiation syndrome. The patient was hospitalized in protective isolation and showed satisfactory recovery without specific therapy. A few unusual features of this case are discussed. (auth)

12943 EFFECT OF PLASMA FROM ANAEMIC RABBITS ON THE POST-IRRADIATION ANAEMIA OF MICE. J. D. Cumming and M. A. Khoyi (Univ. of Birmingham, Eng.). Nature, 193: 1196-8(Mar. 24, 1962).

Studies were made on the effects of injections of small quantities of plasma from anemic rabbits, containing a high concentration of hemopoietine, on the recovery of irradiated mice. Mice were irradiated with a whole-body dose of 550 r and then divided into 4 groups. Group A was uninjected, group B received injections of 0.9% wt/vol solution of sodium chloride in distilled water, group C received injections of normal rabbits' plasma, and group D received injections of anemic rabbits' plasma. The overall mortality was 33% and seemed to be unaffected by experimental procedures. Most deaths occurred between 10 and 12 days after irradiation. Differences in hematological parameters investigated proved to be of statistical significance when group A was compared with group D. The animals in group D also had a significantly higher reticulocyte count than those in group B. Mice receiving normal and anemic plasma lost far less weight during the experiment than those uninjected or receiving saline injections. (P.C.H.)

CHEMISTRY

General and Miscellaneous

12944 (TID-15205) ANALYSIS OF ORIENTATION AND STRENGTH OF BRANCHED POLYMER MODEL SOLID. Technical Report No. 14. T. S. Wu and C. C. Hsiao (Minnesota. Univ., Minneapolis. Inst. of Tech.). Mar. 1961. Contract AT(11-1)-532. 20p.

An analysis was made to determine the effect of molecular orientation on the breaking strength of a branched high polymer model solid. It was found that the relative variation of the strength of a model solid with side chains or branches as a result of either uniaxial or biaxial orientation is less than that without. An attempt was also made to analyze the strength of a specific model which was thought to be approximately analogous to the molecular structure of polymethyl methacrylate. The theoretical result thus obtained agreed fairly well with some known experimental data. (auth)

12945 THE REACTION OF NIOBIUM(V) AND TANTALUM(V) HALIDES WITH ALIPHATIC AMINES. P. J. H. Carnell and G. W. A. Fowles (The University, Southampton, Eng.). J. Less-Common Metals, 4: 40-5(Feb. 1962). (In English)

The reactions of niobium(V) chloride with a range of primary and secondary aliphatic amines were studied, and some of the analogous reactions of niobium(V) bromide and tantalum(V) bromide were also examined. The results of these studies were correlated with earlier work on the reactions of the niobium(V) and tantalum(V) halides with amines. With secondary aliphatic amines, NHR_2, all the halides give aminobasic metal halides, $MX_3(NR_2)_2 \cdot NHR_2$; molecular weight studies on some of these show them to be monomeric in benzene solution. The higher primary amines, NH_2R, give analogous products, $MX_3(NHR)_2 \cdot NH_2R$, but with ethylamine and methylamine there is evidence that a third M−X bond is solvolyzed. Tertiary amines appear to form insoluble adducts. (auth)

12946 INDIUM. Discovery, Occurrence, Development, Physical and Chemical Characteristics and a Bibliography of Indium (Annotated), 1863-1958 Inclusive. Maria Thompson Ludwick, comp. Utica, N. Y., The Indium Corporation of America, 1959. 770p.

The discovery, occurrence, development, physical and chemical characteristics, processing, and applications of indium metal and its alloys are discussed. An annotated bibliography is presented for the period from 1863 to 1958. (N.W.R.)

12947 ARGON, HELIUM AND THE RARE GASES. THE ELEMENTS OF THE HELIUM GROUP. Gerhard A. Cook, ed. Volume I. History, Occurrence, and Properties. New York, Interscience Publishers, 1961. 445p.

A comprehensive and up-to-date summary is presented of the history, occurrence, and physical and chemical properties of the rare gases. (N.W.R.)

Analytical Procedures

Refer also to abstract 13441.

12948 (GA-2211) DETERMINATION OF THORIUM AND URANIUM IN GRAPHITE BY INSTUMENTAL NEUTRON ACTIVATION ANALYSIS. John Buchanan (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Jan. 18, 1962. Contract AT(04-3)-314. 31p.

In studying the migration of Th and U (carbides) in graphite at high temperature there was a need for a simple, rapid method of determining U and/or Th in large numbers of nuclear-grade graphite samples. The amounts of these metals to be determined ranged from submicrogram to milligram quantities and the concentrations from <1 ppm to 20 or 30%. These determinations were accomplished by instrumental neutron activation analysis. The method involved neutron activation of the graphite specimens in a nuclear reactor (TRIGA) and subsequent measurement of the gamma radiation of U and Th activation products by scintillation spectrometry. No chemical treatment of the samples was required because of the high purity of the nuclear-grade graphite. (auth)

12949 (K-1463) URANIUM ISOTOPE MEASUREMENTS WITH A MODEL SU-1 SURFACE IONIZATION MASS SPECTROMETER. V. L. Warren and J. C. Horton (Oak Ridge Gaseous Diffusion Plant, Tenn.). Mar. 22, 1962. Contract W-7405-Eng-26. 13p.

The performance of a twelve-inch radius, 60° sector, single-focusing surface ionization mass spectrometer, Model SU-1 built by Nuclide Analysis Associates, is described. Analyses were made on uranium samples which varied in U^{235} content from 0.23 to 99.8%. Both single and triple filament sample arrangements were used, with and without a vacuum lock for introduction of the sample. All performance requirements in the purchase contract were equalled or exceeded. (auth)

12950 (NAA-SR-Memo-6819) METALLOGRAPHIC ANALYSIS OF WEIGHT PERCENT CARBON IN URANIUM CARBIDE. K. Marnoch (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 20, 1961. Contract [AT(11-1)-Gen-8]. 23p.

A series of UC samples ranging from 4.2 to 5.5 wt % carbon were prepared metallographically and then photographed at 100 and 250 diameters. Concurrently, a metallographic analysis technique was developed to aid in the visual determination of the carbon composition. The method is expected to give reliable observations with an accuracy of between 1 and 2% (0.05 to 0.1 wt % carbon in the range of usage). (auth)

12951 (NP-11585) THE RADIOMETRIC ANALYSIS OF URANIUM-BEARING STEELS. J. L. Horwood (Canada. Dept. of Mines and Technical Surveys. Mines Branch). Nov. 1961. 46p., Available as Can. Dept. Mines and Tech. Surveys, Mines Branch, Tech. Bull. TB-25. $0.25.

A technique is described which utilizes the radioactive properties of U to provide a comparison of the relative U content in steel. Samples can be assayed as solids, loose drillings or chips, and as compressed fragments. (J.R.D.)

12952 (PAN-256/VIII) OZNACZANIE TLENU W SODZIE METALICZNYM. (Determination of Traces of Oxygen in Metallic Sodium). E. Minchevski, D. Dantsevich, and S. Vonsovich (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 12p.

The method for determination of traces of oxygen in sodium consists in amalgamation of sodium by the means of mercury. Insoluble sodium oxide floats on the surface of the amalgam. The amalgam is then washed with mercury and the separated sodium oxide is dissolved in water and

determined on the flame-photometer. The determination is carried out in a simple glass apparatus. Oxygen in the range above 50 ppm was determined. The standard deviation amounted to 3 ppm approximately. (auth)

12953 (PAN-268/X) A SIMPLE METHOD FOR DETERMINATION OF RADIOACTIVE PHOSPHORUS, STRONTIUM, LANTHANUM AND CERIUM IN URINE AND WATER. Zbigniew Jaworowski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Sept. 1961. 9p.

A method for determination of radioactive phosphorus, strontium, lanthanum, and cerium in water and urine is described, which depends on the adsorption of nuclides on the phosphate gel mats. The recovery ranges from 77.0 to 99.5%. The detection limit was found to be about 10 rc/liter. (auth)

12954 (PG-Report-267) ANALYTICAL METHOD FOR THE DETERMINATION OF SILICON, IRON, ALUMINUM, CALCIUM, AND MAGNESIUM IN BERYL ORE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 13p.

A weighed ore sample is fused with alkali carbonates. After dissolution of the cooled melt in water and sulfuric acid, the following process is carried out. For Si, the solution of the ore is evaporated to fumes of sulfuric acid. Silica is filtered out and determined by the HF acid volatilization procedure. For Fe, the cupferrate is separated from the filtrate of the preceding filtration, and determined volumetrically by titration with potassium dichromate solution. For Al, the Al is separated with Be as the hydroxide. The Al is then separated as the oxinate, and is determined gravimetrically. For Ca, the Ca is separated as the oxalate and determined in sulfuric acid solution by titration with potassium permanganate solution. The Mg is separated as magnesium ammonium phosphate and ignited to magnesium pyrophosphate, in which form it is weighed. Each of the above operations is carried out successively on a single sample. The method has been used on ores containing 10 to 13% beryllium oxide. (T.F.H.)

12955 (PG-Report-269) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF COPPER IN URANIUM–ZIRCALOY-2 ALLOY. (United Kingdom Atomic Energy Authority. Production Group, Springsfields, Lancs, England). 1962. 4p.

The cuprous complex with 2,9-dimethyl-1,10-phenanthroline is extracted from a tartrate medium at pH = 5 into chloroform, and the optical absorbancy of this solution is measured. The method is suitable for Cu determinations in the concentration range 10 to 250 ppm. At the 45 ppm level the standard deviation is ±2 ppm, and the method is considered to be free from bias. (T.F.H.)

12956 (PG-Report-271) ANALYTICAL METHOD FOR THE VOLUMETRIC DETERMINATION OF ALUMINIUM IN URANIUM–ALUMINIUM ALLOYS. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 5p.

The Al is separated from U and Fe by passage through a column of anion-exchanger resin, and determined by titration with the disodium salt of ethylenediaminetetraacetic acid and zinc chloride solution. The method is intended for Al contents at the 3% level, but is suitable for Al contents up to 10%. At the 3% level, the precision is 0.04%. (T.F.H.)

12957 (PG-Report-272) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF IRON IN VARIOUS URANIUM ALLOYS. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 5p.

The sample is dissolved in an acid mixture. U is complexed with ammonium tartrate and the iron reduced with hydroxylamine hydrochloride. The iron is determined absorptiometrically at pH 6.0 to 6.5 using 1:10 phenanthroline. The method is applicable to binary alloys of U with Mo, Nb, Al, and Ti. At the 135 ppm level, the standard deviation is ±2.8%. (T.F.H.)

12958 (PG-Report-281) INDEX AND ABSTRACTS OF WINDSCALE ANALYTICAL METHODS. PART 3. P.G. REPORTS (W) SERIES, NUMBERS 114 AND 161-224. J. Barraclough, comp. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 8p.

Abstracts are included of selected Windscale analytical methods for the determination of radioisotopes, elements, and radioactivity in various substances. Subject indexes are given for nature of analysis and for materials determined. (B.O.G.)

12959 (TID-13910) LOW-LEVEL TRITIUM MEASUREMENT WITH THE LIQUID SCINTILLATION SPECTROMETER. Progress Report No. 1. Richard M. Hours and Warren J. Kaufman (California. Univ., Berkeley. Sanitary Engineering Research Lab. and California. Univ., Berkeley. School of Public Health). Oct. 1, 1959. Contract AT(11-1)-34. 54p.

The practical application of tritium to engineering problems involving water tracing is dependent on the availability of a highly sensitive yet economical method of tritium measurement. The liquid scintillation spectrometer affords a methodology for tritiated water detection at concentrations of 10^{-6} μc/ml or less, and is believed to be generally superior to ion chamber or proportional type counters. Detection sensitivity was defined as the quantity of liquid that can be labeled with a unit of radioactivity and subsequently detected with a confidence level of approximately 95 per cent. Detection sensitivity may be expressed formally as a function of counter efficiency, sample volume, background, and counting time. Using a 30-min counting period, sensitivities in excess of 1800 l/μc were obtained with a scintillator comprised of dioxane, naphthalene, PPO, POPOP, and water. Scintillator volumes of over 200 ml were employed with the scintillator in direct optical contact with the photomultiplier tubes of a coincidence type spectrometer. Specifications of an insert cell for use with a commercial liquid scintillation spectrometer are given. The insert cell makes possible detection sensitivities of over 1000 l/μc. A comparison was made of the sensitivities of the single photomultiplier spectrometer and the two-photomultiplier coincidence spectrometer. It was concluded that the two systems can be operated with nearly comparable sensitivities, but for low-level measurements the latter system has the advantage of a more stable background with a lesser liability to thermionic and light-induced phosphorescence disturbances. (auth)

12960 (TIM-406) A FLAME SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF NICKEL AND BORON IN PLATING SOLUTIONS. D. E. Fornwalt (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). May 6, 1957. Contract [AT(11-1)-229]. 25p.

A flame photometric method for rapidly estimating the nickel and boron concentrations in nickel plating solutions is described. The effect of methanol concentration on the flame emission of the 352.5 mμ nickel line in 1 to 1 methanol–water solution was studied. The effect of nickel concentration on the flame emission of boron in 1 to 1 methanol–water solution was studied for the oxide band system at 518 n.μ. (auth)

12961 (USNRDL-TR-551) COCRYSTALLIZATION OF ULTRAMICRO QUANTITIES OF ELEMENTS WITH THIONALID. DETERMINATION OF SILVER IN SEA WATER. M. G. Lai and H. V. Weiss (Naval Radiological Defense Lab., San Francisco). Jan. 19, 1962. 22p.

The cocrystallization of ultramicro quantities of 27 diverse elements with thionalid was investigated by radiotracer techniques. Under optimum pH conditions, greater than 90% of each of the following elements was recovered from solution: Au, Os, Ta, In, Hg, Ag, W, Zn, Sn, Tl, Co, Ir, Ru, Mn, Cr, and Hf. Limited distribution studies revealed that the Doerner-Hoskins distribution was inapplicable and that Fajans Rule was not obeyed. Information derived from these experiments was applied to the isolation and determination of silver in seawater. After radiometric correction for its yield, the concentration of silver in seawater was determined to be 0.145 ± 0.006 μg/l. (auth)

12962 (TT-1003) FAST GREY R. A., A NEW COLORIMETRIC REAGENT. I. SPECTROPHOTOMETRIC MICRODETERMINATION OF ZIRCONIUM. H. Khalifa and M. R. Zaki. Translated by D. A. Sinclair (National Research Council of Canada) from Z. anal. Chem., 158: 1-7(1957). 12p.

The dye Fast Grey R. A. was found to be a sensitive reagent for the colorimetric microdetermination of zirconium. Zr concentrations between 0.02 and 8 ppm at a wavelength of 570 mμ can be determined. The cations Cu^{2+}, Ni^{2+}, and Fe^{3+} have a disturbing effect, but ascorbic acid eliminates the disturbing effect of moderate quantities of iron. U, Co, Al, Th, Bi, Zn, the alkalis, and the rare earths do not affect the results. (auth)

12963 DETERMINATION OF ALUMINUM IN THORIUM COMPOUNDS BY LINEAR-SWEEP OSCILLOGRAPHIC POLAROGRAPHY. T. M. Florence (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Anal. Chem., 34: 496-9(Apr. 1962). (AAEC/TM-122)

A method is presented for the determination of traces of aluminum in thorium compounds by oscillographic polarography using the dye Superchrome Garnet Y (5-sulfo-2′,4′,2-trihydroxyazobenzene). A separation of aluminum is avoided by masking thorium with acetate, and of 35 ions investigated, only Fe^{2+}, Fe^{3+}, Ni^{2+}, Pb^{2+}, and V^{5+} caused significant interference. After a rapid mercury-cathode electrolysis to remove many heavy metals, the method is highly selective for aluminum. The limit of detection is 1 μg of aluminum per gram of thorium with a relative standard deviation of ±3% at an aluminum concentration of 400 ppm, and ±7% at 10 ppm. Results obtained on various thorium compounds showed good agreement between the polarographic method and a spectrophotometric method using 8-quinolinol. (auth)

12964 CONTROLLED-POTENTIAL COULOMETRIC TITRATION OF ANTIMONY. Louise B. Dunlap and W. D. Shults (Oak Ridge National Lab., Tenn.). Anal. Chem., 34: 499-502(Apr. 1962).

Two procedures were developed for the determination of antimony by controlled-potential coulometric titration. The first method involves reduction of Sb(III) to Sb(Hg) at a mercury cathode controlled at −0.28 volt vs S.C.E. in a supporting electrolyte of 0.4M tartaric acid ($H_2C_4H_4O_6$) and approximately 1M HCl. Antimony(V) must be reduced to the trivalent state prior to electrolysis; hydrazine hydrate is a satisfactory reductant. The second procedure involves electrolytic reduction of Sb(V) to Sb(III) and of Sb(III) to Sb(Hg), at −0.21 volt and −0.35 volt vs S.C.E., respectively, in a supporting electrolyte containing 0.4M tartaric acid and 6M HCl. It is therefore possible to determine each oxidation state, as well as total antimony, by this method. Each procedure is characterized by a relative standard deviation of about 0.5% at the 5-mg level. Reasonable amounts of As, Pb, Sn, Fe, Ni, and U do not interfere, or their interference can be eliminated easily. (auth)

12965 DETERMINATION OF RARE EARTHS IN FISSION PRODUCTS BY ION EXCHANGE AT ROOM TEMPERATURE. Kurt Wolfsberg (Los Alamos Scientific Lab., N. Mex.). Anal. Chem., 34: 518-21(Apr. 1962).

A method is described for the routine radiochemical determination of rare earths from fission of uranium. Separation of individual rare earths is achieved by eluting with α-hydroxyisobutyrate solutions through cation-exchange resin columns operated at room temperature. Titration with EDTA as a method of obtaining chemical yield is described. (auth)

12966 ANALYTICAL EXTRACTION OF NEPTUNIUM USING TRI-ISO-OCTYLAMINE AND THENOYLTRIFLUOROACETONE. Richard A. Schneider (General Electric Co., Richland, Wash.). Anal. Chem., 34: 522-5(Apr. 1962). (HW-SA-2216)

An analytical solvent extraction method for separating neptunium from plutonium, americium, curium, uranium, thorium, and fission products using tri-iso-octylamine and thenoyltrifluoroacetone is described. Neptunium is separated from the bulk of the plutonium, americium, curium, and fission products by the extraction of neptunium(IV) into tri-iso-octylamine dissolved in xylene from an aqueous nitric acid reducing solution. The neptunium-bearing organic solution is then scrubbed with a nitric acid reducing solution to achieve further purification. Final purification is obtained by stripping the neptunium from the tri-iso-octylamine−xylene solution into dilute hydrochloric acid and then extracting the neptunium(IV) into thenoyltrifluoroacetone dissolved in xylene. The method is used routinely to separate neptunium-237 from other alpha emitters and fission products in preparation for a quantitative neptunium-237 measurement by alpha-counting methods. (auth)

12967 RAPID SPECTROPHOTOMETRIC DETERMINATION OF TECHNETIUM IN URANIUM MATERIALS. O. H. Howard and C. W. Weber (Oak Ridge Gaseous Diffusion Plant, Tenn.). Anal. Chem., 34: 530-3(Apr. 1962).

Technetium, 0.3 to 30 μg in a 3N acid solution, is determined in the presence of up to 5 grams of uranium, within 15 minutes, with 95% confidence limits of ±0.07 μg at 0.5 μg of technetium, and ±0.2 μg at 30 μg of technetium. The technetium is reduced from Tc(VII) to Tc(V) with ascorbic acid in the presence of iron(III) which prevents reduction below Tc(V). The red technetium(V) thiocyanate complex is formed and extracted into butyl acetate; coextracted ferric thiocyanate is removed with a phosphate wash. The absorbance of the technetium extract is measured at 585 mμ (molar absorptivity 16500) in the presence of molybdenum, or at 510 mμ (molar absorptivity 50000) in the absence of molybdenum. The amount of technetium is obtained from a Beer's law calibration curve. Molybdenum is the only known direct interference—100 μg appearing as 0.4 μg of technetium when the absorbance is measured at 585 mμ. (auth)

12968 USE OF 1,3-DIMETHYLVIOLURIC ACID IN SPECTROPHOTOMETRIC TITRATIONS OF ALKALI AND ALKALINE EARTH SALTS. Murray E. Taylor and Rex J. Robinson (Univ. of Washington, Seattle). Anal. Chem., 34: 533-6(Apr. 1962).

A spectrophotometric study was made of the lithium, sodium, potassium, rubidium, cesium, beryllium, and magnesium salts of 1,3-dimethyl-5-isonitrosobarbituric acid (1,3-dimethylvioluric acid, DMVA). The applicability of DMVA for the spectrophotometric titration of alkali and alkaline earth salts in aqueous solution was investigated. These metals were determined with an accuracy that ranged from 1 to 10 parts per thousand in 0.01 to 0.0001M concentrations. At these concentrations the precision, expressed as standard deviation, ranged from 0.3 to 1.5%. Separation and thermal decomposition of potassium tetraphenylborate yielded water-soluble potassium borate which was titrated spectrophotometrically by DMVA. (auth)

12969 ESTIMATION OF BERYLLIUM WITH ERIOCHROME CYANINE R USING THE RING OVEN TECHNIQUE. Philip W. West and Patricia R. Mohilner (Louisiana State Univ., Baton Rouge). Anal. Chem., 34: 558-60 (Apr. 1962).

A method for the microdetermination of beryllium using Eriochrome Cyanine R and the ring oven technique is presented. Determinations can be made on as little as 0.01 mg per ml (0.05 μg) of beryllium with an average error of 7%. Of the elements likely to be of significance in air pollution studies, none was found to interfere when present in 10-fold excess, and only Mg, Th, Al, and Cr interfere when present in 100-fold excess. (auth)

12970 SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM QUANTITIES OF MANGANESE IN URANIUM AND ALUMINUM WITH 8-HYDROXYQUINALDINE. Kenji Motojima, Hiroshi Hashitani, and Tsuyoshi Imahashi (Japan Atomic Energy Research Inst., Tokyo). Anal. Chem., 34: 571-5(Apr. 1962).

Microgram quantities of manganese were determined using the extraction of the 8-hydroxyquinaldine (2-methyl-8-quinolinol) complex with chloroform and the spectrophotometric measurement of the extract. The method is applied successfully to traces of manganese in uranium after most of the uranium is removed by tributyl phosphate extraction. This method, without preliminary separation of the metal, is used also for the determination of microgram quantities of manganese in aluminum. With both metals, the procedure is more sensitive, precise, and accurate than the usual permanganate method, and is useful for determining manganese down to the 1-ppm level. (auth)

12971 DETERMINATION OF HYDROGEN IN CALCIUM BY VACUUM FUSION. D. T. Peterson (Ames Lab., Ames, Iowa) and V. G. Fattore. Anal. Chem., 34: 579-81(Apr. 1962).

A rapid simple method for the determination of hydrogen in pure calcium is presented. Hydrogen was extracted by a vacuum fusion technique using a tin bath at 670°C to reduce calcium volatilization and to increase the speed of hydrogen evolution. The hydrogen content was determined by measurement of the pressure of the gas collected in a known volume. Samples containing from 200 ppm of hydrogen up to almost pure calcium hydride were successfully analyzed. The precision of the results was always better than 4%. (auth)

12972 POINT SOURCE TECHNIQUE FOR GAMMA RAY ABSORPTION STUDIES. Joseph Bubernak, Marion S. Lew, and George M. Matlack (Los Alamos Scientific Lab., N. Mex.). Anal. Chem., 34: 585-6(Apr. 1962).

A new technique for γ absorptiometric analysis of solutions with a radioactive source such as Am^{241} is reported. The Am is contained as a point source placed in the center of the sample solution. Very little americium is required, about 10^{-9} g; hence the cost is negligible and radiation hazards are eliminated. Gamma absorption curves for Am, Ca, Cu, Hg, Ag, and U are given. (P.C.H.)

12973 ADAPTER TO PERMIT SCANNING OF RADIOCHROMATOGRAMS USING A SIMPLE END-WINDOW COUNTING SETUP. W. D. Conway and E. J. Lethco (National Cancer Inst., Bethesda, Md.). Anal. Chem., 34: 590-1(Apr. 1962).

A simple device is described which permits manual scanning of chromatograms using the end-window counting apparatus usually employed for assaying samples plated on planchets. The adapter is designed to fit the space occupied by the shelf ordinarily used to hold planchets. The set-up is such that there is no danger of altering the counting geometry for planchet counting. Scans of a chromatogram of certain metabolites tagged with C^{14} are given. (P.C.H.)

12974 LIQUID-LIQUID EXTRACTION OF ZIRCONIUM WITH TRI-n-OCTYLAMINE AND DIRECT COLORIMETRIC DETERMINATION WITH XYLENOL ORANGE. E. Cerrai and C. Testa (CISE, Milan). Anal. Chim. Acta, 26: 204-11(Mar. 1962). (In English)

A new, very sensitive method for the non-aqueous colorimetry of zirconium is described. Tri-n-octylamine solutions obtained by liquid-liquid extraction of Zr from the initial 11 N HCl solution are used with xylenol orange as reagent. For pyridine buffered systems a 1:1 complex is formed with insufficient reagent and a 1:2 complex with excess of reagent. For systems buffered with acetic acid, only the 1:1 complex is formed (absorption maximum 550 mμ; $\epsilon = 53{,}300$). The acetic acid method is more sensitive and many foreign ions can be tolerated. Zirconium can be determined in the presence of 10,000 times it amount of non-extractable ions (such as alkali metals, alkaline earths, rare earths, aluminum, etc.) and of 100 or 10 times its amount of many other elements which are extracted by the amine. (auth)

12975 SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(VI) BY THE AZIDE REACTION. F. G. Sherif and Aida M. Awad (Univ. of Alexandria, Egypt). Anal. Chim. Acta, 26: 235-41(Mar. 1962). (In English)

Azide was investigated as a spectrophotometric reagent for uranium(VI). The system is more sensitive than the thiocyanate reaction. It obeys Beer's law in the range of 2 to 180 ppm of uranium. The color is sensitive to hydrogen ion concentration; maximum absorbance and stability are attained at pH 5 to 5.5. Iron(III) interferes seriously, but can be masked by EDTA. Fe^{2+}, Cr^{3+}, Ni^{2+}, Th^{4+}, $Cr_2O_7^{-2}$, WO_4^{-2}, VO_3^-, and F^- interfere. The deep yellow color cannot be extracted with organic solvents. A monoazido-uranium(VI) ion is present in dilute solutions; its dissociation constant is $2.3 \pm 0.27 \cdot 10^{-3}$. (auth)

12976 DETERMINATION OF RHODIUM BY THERMAL NEUTRON ACTIVATION ANALYSIS USING γ-RAY SPECTROMETRY. E. L. Steele and W. Wayne Meinke (Univ. of Michigan, Ann Arbor). Anal. Chim. Acta, 26: 269-74(Mar. 1962). (In English)

Trace amounts of rhodium were determined by thermal neutron activation analysis using both destructive and nondestructive methods. With a neutron flux of 10^{12} n cm^{-3} sec^{-1} the lower limits of detection are about 0.1 μg and 0.01 μg, respectively. A rapid sodium peroxide fusion followed by a pyridine extraction was used in the destructive method to separate the 4.4-min Rh^{104m} from its matrix. The 44-sec Rh^{104} was used in the non-destructive method. Both radioactive isomers were measured by γ spectrometry with a multichannel pulse height analyzer. The aver-

age time required per non-destructive analysis was 7 min while the chemical method averaged 20 min. (auth)

12977 DETERMINATION OF SOLUBLE AND INSOLUBLE ZIRCONIUM IN MAGNESIUM ALLOYS. R. H. A. Crawley (English Electric Co. Ltd., Leicester, Eng.). Anal. Chim. Acta, 26: 281-4(Mar. 1962). (In English)

A method for the determination of soluble and insoluble zirconium is described. To differentiate between the two forms, two solutions are prepared, in one of which the insoluble zirconium remains in suspension; in the other it is brought into solution with hydrofluoric acid. Zirconium is extracted by trioctyl phosphine oxide/petroleum ether and determined in the extract spectrophotometrically with pyridyl-azo-naphthol (PAN) as reagent. (auth)

12978 THE DETERMINATION OF BORON IN ZIRCALOY. M. Freegarde and J. Cartwright (Naval Ordnance Inspection Establishment, Sheffield, Eng.). Analyst, 87: 214-16(Mar. 1962).

An account is given of the development of a simple and reliable procedure for determining boron in Zircaloy at the parts per million level. The sample is dissolved in a mixture of bromine and methanol, and the boron is separated by distillation and determined as its rosocyanin complex with curcumin. The reproducibility of the method is characterized by a standard deviation of 0.03 ppm at the 0.3 ppm level. (auth)

12979 SPECTROPHOTOMETRIC DETERMINATION OF MAGNESIUM IN URANIUM. V. T. Athavale, R. L. Bhasin, and B. L. Jangida (Atomic Energy Establishment, Trombay, India). Analyst, 87: 217-19(Mar. 1962).

A method for determining magnesium in uranium was developed. Uranium is removed by extraction with tri-n-butyl phosphate and then 8-hydroxyquinoline, and magnesium is determined spectrophotometrically at 400 mμ after development of color with 8-hydroxyquinoline in the presence of diethylene glycol monobutyl ether. (auth)

12980 PARR BOMB COMBUSTION OF TISSUES FOR CARBON-14 AND TRITIUM ANALYSIS. H. Sheppard and W. Rodegker (CIBA Pharmaceutical Products, Inc., Summit, N. J.). Atomlight, No. 22, 1-3(Feb. 1962).

The Parr metal oxygen bomb was used for the combustion of biological samples for the determination of low levels of C^{14} and tritium. A system is outlined that was used for hundreds of combustions with excellent results. When tissues containing no radioactivity were combusted after one containing relatively high levels of tritium no contamination was evident. When samples containing only carbon-14 were combusted no radioactivity could be detected in the ethanol washes of the bomb and water trap showing that this system is satisfactory for the combustion of samples containing both carbon-14 and tritium. With the methods outlined it was possible to detect as little as 4.0×10^{-4} microcuries of tritium and 1.0×10^{-4} microcuries of carbon-14 per 3 grams of fresh tissue. (C.H.)

12981 SPECTROPHOTOMETRIC ANALYSIS OF CERIUM AND OF THE RARE EARTHS SAMARIUM, PRASEODYMIUM AND NEODYMIUM. Erich Illner (VEB Carl Zeiss, Jena, Ger.). Chem. Tech. (Leipzig), 13: 717(Dec. 1961). (In German)

Pure cerium oxide is excellently suited for polishing optical glass. Impurities of rare earths, especially praseodymium and neodymium, influence the properties of the cerium oxide polishing agent. An analytical process was developed for quantitative determination of cerium, samarium, praseodymium, and neodymium in the cerium oxide polishing agent by spectrophotometric methods. (tr-auth)

12982 POLAROGRAPHIC DETERMINATION OF NIOBIUM IN PRESENCE OF ETHYLENEDIAMINETETRAACETIC ACID. Sigmar Spauszus and Joachim Hupfer (Deutsche Amt für Material-und Warenprufüng, Prufdienststelle Metallchemie, Magdeburg, Ger.). Chem. Tech. (Leipzig), 13: 750(Dec. 1961). (In German)

The effects of hydrogen ion concentration on the polarographic determination of niobium in the presence of ethylenediaminetetraacetic acid are discussed. It was found that the determination must be made below a pH of 3.5. (M.C.G.)

12983 SELECTIVE DETECTION TEST FOR NIOBIUM WITH METHYLTHYMOL BLUE. E. Lassner (Metallwerk Plansee A.G., Tirol, Austria). Chemist Analyst, 51: 14 (Mar. 1962).

It was found that at pH 3 to 5 the peroxoniobate moiety ($Nb-H_2O_2$) gives an intense blue color with Methylthymol Blue. Since $Nb-H_2O_2$ does not form complexes with diaminocyclohexanetetraacetate (DCYTA), it is possible to secure selectivity in the reaction of $Nb-H_2O_2$ with Methylthymol Blue via the masking action of DCYTA. The rate of color development is slow; a blue color is attained at room temperature within 30 to 40 min, but in boiling solution the reaction is complete after 1 min. The detection limit is 5 μg and the limit of dilution, 1:800000. Ta, Ti, Mb, W, Th, and Zr do not interfere. If the amount of Nb present is less than that required to fully complex the amount of dye added, the test color is a red-violet or violet, rather than blue. (P.C.H.)

12984 VANADATE AS AN OXIDIMETRIC REAGENT: REVIEW OF APPLICATIONS. Antonin Berka, Jaroslav Vulterin, and Jaroslav Zyka (Charles Univ., Prague). Chemist Analyst, 51: 24-5; 27-30(Mar. 1962).

A review is given on the use of vanadate as an oxidimetric reagent. Applications with several ions such as As(III), Hg(I), Tl(I), Mb(V), W(V), U(IV), Fe(II), V(III), Ti(III), Cu(I), and diverse metals such as Pb, Ca, Co, Zn, Os, Ni, Pd, Pt, Ag, Sb, and Se, and iodide, thiocyanate, sulfide, thiosulfate, sulfate, dithionate, and polythionates, phosphite and hypophosphite, hydrazine and its derivatives, several organic substances, and other diverse inorganic substances are briefly described. Vanadate is an important oxidimetric reagent because of its excellent solution stability and its pronounced oxidative properties. 87 references are given. (P.C.H.)

12985 THE DETERMINATION OF SODIUM AND POTASSIUM IN BIOLOGICAL MATERIAL BY NEUTRON ACTIVATION ANALYSIS. J. Pijck and J. Hoste (Universiteit, Ghent). Clin. Chim. Acta, 7: 5-12(Jan. 1962). (In English)

Two procedures for the determination of sodium and potassium in biological fluids, by radioactivation analysis, were developed. In the chemical separation technique, samples of the order of 1 μl were irradiated in silica capillaries. Sodium was measured selectively by γ-counting with energy discrimination, whereas potassium was separated as its dipicrylamine- or tetraphenylboron salt and counted with a G. M. tube. The method was tested on solutions of known content and applied to human blood serum. Reproducibility proved to be better than 5% for sodium and better than 10% for potassium. When samples of the order of 10 μl were available, the determination of both elements was possible without chemical separation. Samples and standard solutions were applied on a paper

strip and irradiated. Direct and specific γ-counting of the sodium and β-counting of the potassium isotopes is then possible with a reproducibility generally better than 10%. (auth)

12986 ACTIVATION ANALYSIS OF OXYGEN, CARBON, AND NITROGEN WITH THE (γ,n) REACTION. Philippe Albert, Charles Englemann, Serge May, and Jean Petit (C.N.R.S., Saclay, France and Centre d'Études Nucléaires, Saclay, France). Compt. rend., 254: 119-21(Jan. 3, 1962). (In French)

The possibilities of determining carbon, oxygen, and nitrogen by (γ,n) reactions were evaluated theoretically in order to assure the best experimental conditions. A series of preliminary tests permitted oxygen and carbon to be determined in beryllium, without separation, with a sensitivity of 10×10^{-6}. Some suitably chosen chemical separations permitted the determination of nitrogen and carbon in aluminum, beryllium, iron, and zirconium with a sensitivity of 0.3×10^{-6}. (tr-auth)

12987 ELIMINATION OF THE INTERFERING BACKGROUND IN SPECTROSCOPIC N^{15} ISOTOPE ANALYSIS. G. Meier (Institut für Physikalische Stoffternnung, Leipzig). Isotopentechnik, 1: 251(Nov. 1961). (In German)

It is shown that the interfering background, caused by traces of water, in the spectroscopic determination of N^{15} can be eliminated by cooling. (tr-auth)

12988 GRAVIMETRIC DETERMINATION OF SCANDIUM USING MANDELIC ACID. I. P. Alimarin and Han-hsi Shên (Han-si Shen) (Moscow State Univ.). Talanta, 9: 1-7(Jan. 1962). (In English)

A new method for the gravimetric determination of scandium using mandelic acid and a method for separating scandium from rare earths and thorium were developed. The composition of the precipitate corresponds to the formula $H_3[Sc(C_8H_6O_3)] \cdot nH_2O$. Thermogravimetric examination of this compound showed that it decomposes at 280°. Scandium mandelate dissolves in ammonia with the formation of $(NH_4)_3[Sc(C_8H_6O_3)_2]_3$. (auth)

12989 DETERMINATION OF ZIRCONIUM USING N-BENZOYLPHENYLHYDROXYLAMINE. I. P. Alimarin and Yun-yang Tsê (Yung-schaing Tze) (Moscow State Univ.). Talanta, 9: 9-13(Jan. 1962). (In English)

A new method was developed for the quantitative precipitation of zirconium with N-benzoylphenylhydroxylamine. The influence of different mineral acids, tartaric acid, and hydrogen peroxide on the completeness of the precipitation was studied. Precipitation of zirconium in the presence of other elements was also investigated. It was found that zirconium can be separated from iron, aluminum, chromium, titanium, niobium, and tantalum. The composition of zirconium benzoylphenylhydroxylaminate was determined. The precipitate separated from a strong acid solution corresponds to the formula $Zr(BPHA)_4$. (auth)

12990 IN THE COMPLEXOMETRIC DETERMINATION OF PLUTONIUM IN REACTOR FUEL PROCESSING PLANT SOLUTIONS. I. NITRIC ACID SOLUTIONS OF IRRADIATED URANIUM. D. H. Boase, J. K. Foreman, and J. L. Drummond (United Kingdom Atomic Energy Authority, Windscale Works, Calderbridge, Eng.). Talanta, 9: 53-63 (Jan. 1962). (In English)

An accurate and precise method for the determination of plutonium in nitric acid solutions of irradiated uranium is described. Plutonium(IV) is extracted using the quaternary amine Hyamine 1622 dissolved in benzene; the benzene is removed by evaporation and, after dissolution of the residue in acetone, an excess of ethylenediaminetetraacetic acid (EDTA) is added and the uncomplexed EDTA determined by photometric titration using standard zinc chloride solution and dithizone as indicator. The extraction is highly specific for plutonium and a two-stage cycle results in a decontamination factor of approximately 10^5 for mixed fission products and 10^2 for uranium. Under carefully controlled conditions the method yields a standard deviation of 0.4% for 10^2-μg amounts of plutonium. (auth)

12991 SEMIMICRO DETERMINATION OF STRONTIUM AND CALCIUM IN MIXTURES. C. Heitner-Wirguin and A. Albu (Hebrew Univ., Jerusalem). Talanta, 9: 79-81 (Jan. 1962). (In English)

A method is described for the quantitative separation and determination of about 5 mg of strontium and 0.5–5 mg of calcium, by precipitation of strontium at pH ~ 6 with sodium rhodizonate, and determination of both ions by complexometric titrations. (auth)

12992 A SPOT TEST FOR URANIUM^{VI} WITH RESACETOPHENONE-OXIME. C. Rama Rao (Andhra Univ., Waltair, India). Talanta, 9: 81-3(Jan. 1962). (In English)

A spot test for the detection of uranium(VI) using resacetophenone-oxime was developed. It was found that a reddish brown color develops when solutions of uranium(VI) and resacetophenone-oxime are mixed in ammoniacal medium. The limit of identification is 0.595 μg. (auth)

12993 PHOTOMETRIC DETERMINATION OF SCANDIUM WITH α-(2,4-DIHYDROXYPHENYLAZO)-PYRIDINE. A. I. Busev and Fan Chang (Moscow State Univ.). Talanta, 9: 101-6(Feb. 1962). (In English)

Under certain conditions the scandium ion gives a characteristic coloration with α-(2,4-dihydroxyphenylazo)-pyridine on interaction with it in the molar ratio 1:1. A photometric method was worked out for the determination of 0.05–2 μg of Sc/ml using this reagent. Be, Mo, Ca, and Mg do not interfere with the determination, but Zn, Co, Ni, Cd, Cu, Tl, In, Ga, Zr, Th, U, and Fe do. (auth)

12994 PHOTOMETRIC DETERMINATION OF MOLYBDENUM IN THE QUINQUEVALENT STATE BY MEANS OF 8-HYDROXYQUINOLINE-5-SULPHONIC ACID. A. I. Busev and Fan Chang (Moscow State Univ.). Talanta, 9: 107-11(Feb. 1962). (In English)

A new photometric method was worked out for the determination of small quantities of molybdenum (after its reduction to the quinquevalent state with hydrazine hydrochloride) using 8-hydroxyquinoline-5-sulfonic acid. From 3 to 20 mg of molybdenum can be determined by the method. Large quantities of W, as well as Mg, Ca, Ba, Ni, Cd, Al, Th, Mn(II), Cr(III), and small quantities of Bi, Ca, and U do not interfere with the determination of molybdenum. (auth)

12995 THE DETERMINATION OF INTERSTITIAL ELEMENTS IN THE REFRACTORY METALS. Manley W. Mallett (Battelle Memorial Inst., Columbus, Ohio). Talanta, 9: 133-44(Feb. 1962). (In English)

A review is presented of current and potentially applicable methods for the determination of oxygen, nitrogen, hydrogen, and carbon in molybdenum, tungsten, niobium, and tantalum. Discussion is given on neutron activation, halogenation, fractography, mass spectrometry, isotopic dilution, emission spectrometry, vacuum fusion, and inert-gas fusion, and practical applications of oxygen, nitrogen, hydrogen, and carbon methods. (P.C.H.)

General Inorganic and Physical Chemistry

Refer also to abstracts 12833 and 12843.

12996 (CNEN-107) THE ION EXCHANGE BETWEEN BENZENE SOLUTIONS OF TRILAURYLAMINE NITRATE AND SOLID ANION EXCHANGE RESINS. G. Klotz, G. Scibona, and M. Zifferero (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Dec. 1961. 17p.

The exchange between benzene solution of trilaurylamine nitrate (with $[HNO_3]org/[amine] > 1$) and Dowex 1, chloride form, was investigated. Both trilaurylamine nitrate and nitric acid in excess with respect to the amine concentration exchange the resin chloride, with two different partition coefficients $D_|$ and $D_{||}$. The exchange reaction follows the mass action law. The amount of nitrate exchanged in the resin has been found to depend on the fourth root of TLA nitrate concentration ($[HNO_3]org/[TLA] = 1$) and to be linearly dependent on the nitric acid concentation in excess of TLA concentration ($[HNO_3]org/[TLA] > 1$). (auth)

12997 (CNLM-1724) SURVEY: OXIDATION CHARACTERISTICS OF COLUMBIUM AND COLUMBIUM BASE ALLOYS. W. R. Clough, E. C. Hirakis, and R. C. Krutenat (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). May 20, 1959. Contract [AT(11-1)-229]. 77p.

Unclassified experimental data concerned with the oxidation characteristics of Nb and Nb-base alloys are presented. The bulk of the results is presented in tabular form and cataloged under laboratory name sub-headings. The theory of alloy development for oxidation resistance is discussed. Methods of evaluating oxidation behavior are outlined. (M.C.G.)

12998 CNLM-1802-2) PURIFICATION OF ARGON, HELIUM AND XENON. A Bibliography. E. A. Cernak, comp. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Sept. 16, 1959. Contract [AT(11-1)-229]. 18p.

The bibliography contains 145 references on the technology and apparatus used in the purification of Ar, He, and Xe, and on the analysis for H_2O, CO, H_2, N_2, and O_2 in the purification process. The material covers the period 1938 through 1959. (M.C.G.)

12999 (CNLM-2370-2) HYDRIDES OF TITANIUM, YTTRIUM, AND ZIRCONIUM. A Bibliography. Elizabeth A. Cernak, comp. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Apr. 28, 1960. Contract [AT(11-1)-229]. 16p.

A bibliography on metal hydrides with emphasis on those of Ti, Y, and Zr is presented. The bibliography is on information published from 1955 through 1959. (94 references). (J.R.D.)

13000 (DC 61-1-700) A SHORT LABORATORY INVESTIGATION OF RADIO-IODINE PLATEOUT. G. Tuck and M. N. Myers (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 20, 1960. Contract AT(11-1)-171. 17p.

The removal and plateout of radio-iodine was studied by blowing hot air through a short section of $\frac{3}{8}$ inch stainless steel tubing containing plated-out fission products and thence through a 30 ft. clean $\frac{3}{8}$ tube. The removal of I by the air at various temperatures and the subsequent plate out in the clean tubing was measured. (auth)

13001 (HW-67364) LABORATORY INVESTIGATION OF DECONTAMINATING SOLUTIONS FOR PRIMARY LOOP DECONTAMINATION IN THE NEW PRODUCTION REACTOR. J. E. Mendel (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 8, 1960. Contract W-31-109-eng-52. 21p.

An investigation was made of methods for decontaminating the primary loop of the New Production Reactor (NPR). Decontamination factors ranging from fifty to several thousand were obtained with several different combinations of cleaning solutions. In general, fission product activity was removed to a lower residual level than was activated corrosion product activity, and carbon steel was easier to decontaminate than was stainless steel. It was necessary to completely remove the oxide film from the metal surfaces to obtain adequate activated corrosion product decontamination. Descaling procedures were also satisfactory for decontaminating fission product and uranium dioxide contamination. (M.C.G.)

13002 (NLCO-836) HYDROGEN IN URANIUM. F. E. Jenkins and T. J. Keefe (National Lead Co. of Ohio, Cincinnati). June 15, 1961. Contract AT(30-1)-1156. 65p.

Methods for determining hydrogen in uranium were compared and the effects of some of the differences in preparatory methods were determined. It was found, for instance, that sample preparation procedures that do not remove minute films of water, grease, or other hydrogenous contamination and samples with large surface-area-to-mass ratios contribute to imprecise and biased analytical results. The results of a survey of the hydrogen concentration in materials charged to the vacuum remelt process and products of the metal production and core fabrication processes are reported. Process data were taken, and factors most significant to the introduction of hydrogen into uranium are described. Process steps useful in minimizing the concentration of hydrogen in cores are as follows: balanced charges of process feeds that contain low and high concentrations of hydrogen; low remelt furnace pressures; low partial pressures of water in the atmosphere surrounding molten salt heat-treating baths; magnetic induction heat treatment; and facilities for degassing cores. A rejection limit was derived for ingots which assures that the specification for the maximum concentration of hydrogen in cores will not be exceeded. (auth)

13003 (NP-11299) IMPROVED OXIDATION RESISTANCE OF MOLYBDENUM BY ALLOYING WITH RARE EARTH AND OTHER SELECTED METALS. (Colorado School of Mines Research Foundation, Inc., Golden). Jan. 17, 1962. Contract NOw-62-0305-d. 4p.

Sm, Ho, Er, Zr, and Y are found to form stable, non-hygroscopic, high-melting-point molybdates and oxides. Further, mixtures of these oxides with MoO_3 form no low-melting eutectics over a wide composition range. The characteristics of these metals as alloys with Mo, and of their oxides as coatings on Mo are outlined. The melting points and the % expansion as a function of temperature from 600 to 1325°C are given for the molybdates and oxides. Other rare earths than Sm, Ho, and Er are found to be impractical because of their high hygroscopicity (La, Ce, Pr, Nd) or their high cost. (T.F.H.)

13004 (NP-11411) CANADIAN URANIUM RESEARCH FOUNDATION FELLOWSHIP PROGRESS REPORT NO. 6104, JULY 15–SEPTEMBER 15, 1961. J. Ciric (Canada. Ontario Research Foundation, Toronto). Sept. 15, 1961. 43p. (CURF-R-18)

Glass formation regions in the systems, $K_2O-B_2O_3-UO_2$ and $(Li,Na,K)_2O-B_2O_3-UO_2$ were investigated. In the system, $K_2O-B_2O_3-UO_2$, reaction between the components was found to be very slow at 10 to 20% K_2O content. Preliminary tests indicated that oxidation to hexavalent uranium oxide by air oxygen is required in order to obtain glasses. In the system $(Li,Na,K)_2O-B_2O_3-UO_2$, the glass forming area was restricted to compositions above 45% B_2O_3 line. Below this limit, tendency to form glass-crystalline bodies was found. Glasses containing as much as 40% alkali oxide could be prepared. Densities and refractive indices of glasses were determined. Qualitative fluorescence tests were carried out. (auth)

13005 (NP-11598) TERNARY MINERALS AND COMPOUNDS: AN ANNOTATED BIBLIOGRAPHY. A. A. Beltran, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Feb. 1962. 38p. (SB-62-4)

Seventy references are given to reports and U. S. and foreign journals on ternary minerals and compounds of metallic elements with Group V metallics and Group VI nonmetallics (selenides, sulfides, and tellurides). The period from 1959 to 1961 is primarily covered, however, theses from as early as 1947 and a few Russian articles from 1955 are included. A separate subject index is given. (P.C.H.)

13006 (SRO-44) THE USE OF RADIOISOTOPES IN THE STUDY OF MODIFICATIONS OF PLATINUM CATALYSTS. Final Report Covering Period April 1, 1959 to June 30, 1961. James A. Stanfield (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Aug. 20, 1961. Contract AT(38-1)-202. 69p.

It was found that in the presence of Adams' platinum catalyst acid, mesityl oxide is first hydrogenated to the saturated ketone at a rate of 627×10^{-4} min^{-1} g^{-1} and is then hydrogenated to the saturated alcohol at a rate of 17.7×10^{-4} min^{-1} g^{-1}. In ethanol as a solvent, only the first step was observed, occurring at a rate of 504×10^{-4}. The addition of ferrous chloride to the acetic acid-hydrogenation mixture led to a rate increase of about 17% for the hydrogenation of the olefin bond. In ethanol solvent, the rate of olefinic bond reduction was decreased about 8% with no observable trend being noted. When the reaction was effected in the presence of zinc acetate, the rate of the first step increased to a maximum of 769×10^{-4} at 4×10^{-5} moles of added zinc acetate, but showed a decrease to 383×10^{-5} by the time that 25×10^{-5} moles had been added. The rate of the second step was noted to decrease over the entire range of added Zn salts. Similar effects for the first step were noted in ethanol solvent. Studies were also made using cinnamaldehyde as the acceptor, freshly distilled aldehyde being hydrogenated at a rate of 297×10^{-4} in acetic acid and at a rate of 233×10^{-4} in ethanol. Addition of zinc acetate to the acetic acid-hydrogenation mixture yielded a slight increase in rate (to a value of 334×10^{-4} when 0.05×10^{-3} millimoles were added); however, continued larger additions of the salt resulted in a continued decrease in observed rate. On the other hand, in ethanol as solvent, a rate increase of about 33% was noted even when only 10×10^{-5} moles of salt had been added. The only technique adaptable to the determination of the very small amounts of metal ions adsorbed on the catalyst is that employing radioactive Zn^{65} solutions. Hydrogenations were effected in which varying amounts of the standard radioactive zinc solution had been added to the reaction mixture. The rates of these reactions were determined and were found to be comparable to those reaction mixtures to which zinc acetate was added. At the conclusion of the reaction, the catalyst, now having some radioactive and nonradioactive Zn adsorbed on its surface, was carefully removed from the mixture, washed, and dried. The catalysts were then analyzed for the amount of Zn salt adsorbed on the surface using the same counting techniques as were used for the standard catalyst sample. These comparison studies indicated that the adsorption of the Zn on the catalyst surface was related in an asymptotic way to the amount of salt added to the reaction mixture. While the greater % adsorption was noted at lowest added amounts, the actual amount of material adsorbed increased until 15×10^{-3} millimoles were adsorbed for 250×10^{-3} millimoles of salt added. Factors influencing the adsorption, such as H (presence or absence), acceptor, isolation time, and air (presence or absence) were studied. Once the Zn salts had been adsorbed, it was not found possible to remove them by extensive washing with either alcohol, acetic acid, or water. Methods for the chromatographic analyses of the products of the hydrogenation were studied and developed. From these it was found at 50% hydrogenation the product consisted of 25% of 3-phenylpropanal and 37.5% each of the starting compound (cinnamaldehyde) and 3-phenyl-1-propanol. (auth)

13007 (TID-14744) AROMATIC HYDROGEN EXCHANGE. Annual Report [No.] 1, April 15, 1961 to December 31, 1961. A. J. Kresge (Illinois Inst. of Tech., Chicago). Jan. 1962. Contract AT(11-1)-1025. 35p.

Progress is reported on studies of the mechanisms of aromatic hydrogen exchange for tritium transfer from 1,3-dimethoxybenzene, labelled in both the 2- and 4-positions, to $HClO_4$ at 25 to 45°C; and the isotope effects in aromatic hydrogen exchange for tritium and deuterium transfer from 1,3,5-trimethoxybenzene, labelled in the 2-position, to $HClO_4$ at 25°C in light and heavy water mixtures for tritium, and in light water for deuterium transfer. Methods used in the synthesis of pentamethoxybenzene and 1,3,5-trimethoxy-2,4-dimethylbenzene are described. (B.O.G.)

13008 (TID-15006) ANNUAL REPORT ON STUDIES OF EXCHANGE BETWEEN MOLTEN SALTS AND SOLIDS. W. C. Orr, R. Ward, A. L. Plumley, P. Vilinskas, and T. R. Schleifer (Connecticut. Univ., Storrs). Nov. 30, 1961. Contract AT(30-1)-1154. 23p.

The exchange of sodium ions from molten sodium chloride for potassium ions in solid potassium hexatitanate was investigated. The exchange is rapid and reversible, and serves as a means of obtaining sodium hexatitanate, $Na_2Ti_6O_{13}$, in the same fibrous form as the original potassium compound. An equilibrium constant of approximately unity was found for the exchange reaction. Density and x-ray diffractometer measurements made in order to characterize the artificially prepared sodalite ($Na_8Al_6Si_6O_{24}Cl_2$) used in previous exchange studies revealed the presence of a vitreous component. Improved methods for preparing crystalline sodalite were developed. A zinc borate ($4ZnO \cdot 3B_2O_3$) whose structure is analogous to that of sodalite was prepared, and its use in exchange studies is proposed. (auth)

13009 (TID-15149) A COMPARISON OF TRITIUM AND DEUTERIUM ISOTOPE RATE AND ARRHENIUS PARAMETER EFFECTS. Interim Report, March 15, 1961 to March 1, 1962. V. J. Shiner, Jr. (Indiana Univ. Foundation. Research Div., Bloomington). Contract AT(11-1)-1008. 15p.

Synthesis of the starting material, ethyl hydrotropate-2-d, for tritium isotope effect studies is in progress. An analysis of the mechanisms involved in the synthesis is

presented. It is noted that this material must be exchanged with ethanol-d (T) to introduce the radioactivity. Work on the mechanism of glycidic acid decarboxylation, a step in the synthesis, is almost complete. (J.R.D.)

13010 (TID-15150) PHASE EQUILIBRIA STUDIES OF SYSTEMS INVOLVING THE ALKALI AND ALKALINE EARTH METALS. Report No. VI [for Contract Period] June 1, 1961 to May 31, 1962. Frank A. Kanda and Aden J. King (Syracuse Univ., N. Y. Research Inst.). Mar. 1962. Contract AT(30-1)-1910. 42p.

Equilibrium studies were conducted on the Ba–Na, Na–Sr, Mg–Sr, Li–Sr, and Ca–Li systems. Design of an adiabatic high-temperature calorimeter which is currently under construction is described. (J.R.D.)

13011 (TID-15197) STUDIES IN MOLECULAR SPECTROSCOPY INFRARED SPECTRA AND BONDING OF METAL CARBONYL COMPOUNDS (thesis). Robert William Summitt (Purdue Univ., Lafayette, Ind.). Aug. 1961. Contract [AT(11-1)-164]. 92p.

The infrared spectra of cobalt carbonyl hydride and cobalt carbonyl deuteride were obtained. The H stretching vibration was located at 1934 cm^{-1}, which shifted to 1397 cm^{-1} in the deuteride for a frequency ratio of 1.38. Two lower frequency fundamentals at 704 and 331 cm^{-1}, which together shift by a factor of 1.31, were assigned as modes resulting from the interaction of a "pure" H bend and a "pure" CO bend. Other weak bands were located in the middle frequency region (300-600 cm^{-1}) which could be assigned to missing $Co(CO)_4$ skeletal fundamentals. The H vibrations together with the remainder of the spectra are taken as positive evidence for a model of C_{3v} symmetry, with the H bonded principally to the Co atom. An assignment of observed frequencies is made and the bonding of the H atom and the CO groups is discussed. The infrared spectrum of iron pentacarbonyl was obtained at 300 to 850 cm^{-1}, with special attention to purity of samples and the search for weak bands which might be fundamental vibrations. Gaseous $Fe(CO)_5$ was examined, and it was found that certain liquid-vapor frequency shifts were observed which reconciled in part the middle frequency infrared data with the published Raman spectrum. Both infrared and Raman data were considered from the stand point of consistency with a trigonal bipyramid of D_{3h} symmetry. A satisfactory agreement was found with the spectra, and a tentative assignment of frequencies was made. (auth)

13012 (TID-15227) [PART] I. THE THERMODYNAMICS AND KINETICS OF COORDINATION COMPOUNDS. II. THE CHEMISTRY OF URANIUM SALTS IN SOLUTION. Progress Report, 1961–1962. Michael Cefola and Philip S. Gentile (Fordham Univ., New York). Mar. 1, 1962. Contract AT(30-1)-906. 98p.

Five papers are included; three are abstracted separately in NSA. The papers not abstracted include information on electromotive force measurements of the cell Pt, H_2, HCl, AgCl–lg in 1-propanol–water mixtures and spectral analyses of nickel–urea complexes. 64 references are given. (P.C.H.)

13013 (TID-15227(p.3-32)) DETERMINATION OF THE STABILITY CONSTANTS OF ACETYLACETONE IN MIXED SOLVENTS. P. S. Gentile, M. V. Orna, M. Cefola, and A. V. Celiano (Fordham Univ., New York).

Experiments were made to determine some valid relation for both ligands and chelates over a large dielectric constant range for common solvents. Acetylacetone was used as the ligand and copper perchlorate was chosen as the salt. K_D, K_1, and K_2 were determined in a number of aqueous mixtures of ethanol, methanol, dioxane, 1-propanol, and 2-propanol at a fixed temperature. K_D was also determined in dioxane–water and methanol–water mixtures at several different temperatures in order to examine the effect of the solvent on the thermodynamic functions. Dissociation constants of acetylacetone in the ternary system ethanol–methanol–water at 25°C were also measured. Data obtained on acetylacetone in a three-component solvent show conclusively that parameters which appear to be valid in a two-component system, such as mole fraction or mole percent, have no universal significance. (P.C.H.)

13014 (TID-15227(p.36-64)) THERMODYNAMIC FUNCTIONS OF ACETYLACETONE IN MIXED SOLVENTS. P. S. Gentile, M. V. Orna, M. Cefola, and A. V. Celiano (Fordham Univ., New York).

Thermodynamic functions of acetylacetone were measured in dioxane–water and methanol–water mixtures. It is shown how stability constant data obtained at different temperatures in mixed solvents may be utilized in separating the temperature effect from the dielectric constant effect on thermodynamic functions. Data are tabulated. (P.C.H.)

13015 (TID-15227(p.65-79)) DETERMINATION OF THE STABILITY CONSTANTS OF COPPER WITH ACETYLACETONE IN MIXED SOLVENTS. P. S. Gentile, M. V. Orna, M. Cefola, and A. V. Celiano (Fordham Univ., New York).

The effect of solvents on the dissociation of cupric acetylacetonate was determined. The solvents used were water and ethanol, methanol, dioxane, and 2-propanol mixtures. In order to afford comparison between all the solvents used, even those for which no activity coefficient data were available, and also to avoid assumptions regarding the metal ion in mixed solvents which might prove invalid, the stability constants calculated for the chelate are the concentration constants. It was found that the solvent effect on the coulombic forces governing the stability of a particular chelate and its ligand is quite different from the effect of the ligand change alone. The data are tabulated. (P.C.H.)

13016 (TID-15229) ELECTROCHEMISTRY IN PYRIDINE. I. POLAROGRAPHY AND MACROSCALE ELECTROLYSIS OF INORGANIC SALTS. Report No. 67. Andrzej Cisak and Philip J. Elving (Michigan. Univ., Ann Arbor. Dept. of Chemistry). Sept. 15, 1961. Contract AT(11-1)-70. 26p.

The use of pyridine as a typical aprotic solvent for polarographic and macroscale electrolysis was investigated. The silver electrode in 1 M silver nitrate in pyridine (NAgE) is a reliable reference electrode; its potential vs. the aqueous saturated calomel electrode is 0.09 volts (liquid junction potentials included). Lithium chloride and nitrate, and tetra-n-butylammonium iodide are satisfactory as background electrolytes; decomposition potentials at the dropping mercury electrode (DME) vs. NAgE are Li(I) –2.0 volts and Bu_4NI –2.3 volts Tl(I) and Pb(II) are apparently reversibly reduced in diffusion-controlled processes to the metal, i.e., amalgam, whereas Zn(II) is reduced in two one-electron steps; half-wave potentials at the DME vs. NAgE are Tl(I) –0.48 volts, Pb(II) –0.61 volts (nitrate media) and –0.96 volts (chloride media), and Zn(II) –1.61 volts (wave I) and –1.70 volts (wave II). Solutions of Al(III) give a well-defined polarographic wave, which is due not to reduction of the Al(III) but to that of the solvent. (auth)

13017 (UCRL-9873) ELECTRON SPIN RESONANCE LINE WIDTHS OF TRANSITION METAL IONS AND COMPLEXES IN SOLUTION (thesis). Robert G. Hayes (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 29, 1961. Contract W-7405-Eng-48. 92p.

The line width of $Cr(CN)_5NO^{3-}$ has been measured be-

tween 0 and 100°C at 9000 and at 3000 Mc/sec. The line width increases linearly with temperature. It is shown that the relaxation in this ion is most probably due to modulation of the hyperfine coupling constant by vibrations of the complex. The spectrum of $Cr(CN)_5NO^{3-}$ in solution has been reexamined. The isotropic coupling constants were determined to be $A(N^{14}) = 5.4$ oe for the coupling to the NO nitrogen; and $A(Cr^{53}) = 18.0$ oe, $A(C^{13}) = 6.1$ oe for coupling to the CN carbon nuclei. These results are in partial agreement with published results. The discrepancies are discussed. The spectrum of $K_3Cr(CN)_5NO$ diluted with $K_3CO(CN)_6$ has been examined. The analysis is incomplete, but tentative values of the principal magnetic parameters are $g_{||} = 1.975 \pm 0.005$, $g_{\perp} = 2.003 \pm 0.002$, $A_{||} = 2.0 \pm 0.5$ oe, and $A_{\perp} = 7.2 \pm 0.2$ oe. The line width of Cu^{2+} has been examined in solutions of $Cu(NO_3)_2$ at 9000 Mc/sec between −10 and 80°C. The line, which contains unresolved hyperfine structure, broadens linearly with temperature above room temperature. Below room temperature the line becomes asymmetric and is partially resolved at −10°C. The effect of Jahn-Teller distortions on the line width of this ion is briefly discussed. The line widths of $Cr(H_2O)_6^{3+}$, $Cr(NH_3)_6^{3+}$, CrF_6^{3-}, and $Cr(CN)_6^{3-}$ have been measured between room temperature and 100°C. All four ions have widths that decrease as the temperature is increased. The line widths of all four ions show the same rate of decrease as the temperature is raised. This slope yields an activation energy of 2.6 kcal/mole. The line widths of Mn^{2+} in solutions containing ClO_4^-, SO_4^{2-}, and Cl^- have been measured between room temperature and 180°C. The ClO_4^- solutions have a width that decreases with temperature increase until about 100°C, when it becomes constant. The SO_4^{2-} and Cl^- solutions behave like the ClO_4^- solutions at lower temperatures, but the width increases again at higher temperatures. This increase is interpreted as the effect of complex formation between Mn^{2+} and the anion. Analysis of the data yields $k(20°C) = 1 \times 10^9$ liter $(mole)^{-1}(sec)^{-1}$ ($\Delta E = 4.9$ kcal/mole) for the rate of formation of SO_4^{2-} complexes, and $k(20°C) = 3.4 \times 10^7$ liter $(mole)^{-1}(sec)^{-1}$ ($\Delta E = 10.2$ kcal/mole) for the rate of formation of Cl^- complexes. (auth)

13018 (UCRL-9944) MAGNETIC RESONANCE OF METALS AND PARAMAGNETIC IONS IN SOLUTION (thesis). Judith Brown (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 13, 1961. Contract W-7405-eng-48. 73p.

Several methods of conducting electron spin resonance experiments to 600°C are described. The system lithium in lithium iodide was studied to observe the resonance of lithium metal dissolved in molten lithium iodide. No resonance was observed, from which it is deduced that $T_2 < 2 \times 10^{-10}$ sec. The relaxation times and g values of lithium metal in lithium iodide were measured at temperatures below the lithium iodide melting point. The was no variation of g value, but the relaxation time at 425°C is greater than its room-temperature value by approximately 20%. The line shape was found to vary with temperature and to depend on sample treatment prior to measurement. Electron spin resonance measurements of the line width of ultraviolet-irradiated lithium hydride at temperatures greater than 25°C were made to test the hypothesis that the line arises from colloidal lithium metal. The intensity of the line was drastically reduced at 95°C, and the line had disappeared completely at 170°C. Electron spin resonance studies were conducted from 25 to 500°C on the systems $MnCl_2$, $MnCl_2 \cdot 4H_2O$, $MnCl_2$ in $ZnCl_2$, $MnCl_2$ in LiCl−KCl, $CrCl_3$, $CrCl_3$ in $ZnCl_2$, $CrCl_3$ in LiCl−KCl, $NiCl_2$ in LiCl−KCl, $FeCl_3$, $FeCl_3$ in LiCl−KCl, and $VOCl_2$ in LiCl−KCl. In the solutions resonances were observed only in Mn(II) and Cr(III). For Mn(II) solutions the line width decreases with increasing temperature and increasing concentration. The concentration effect is from exchange narrowing, and it is shown that the exchange phenomenon is still significant at a concentration of 0.3 M. The results in Mn(II) solutions are compared with several theories of relaxation in liquids, with poor agreement. No variation of line width with temperature was observed in solutions of Cr(III). In addition, the line width was found to be the same for the Cr(III) solutions as for the mixed powders of the same concentration. Some interesting temperature effects encountered in the solids are reported. (auth)

13019 (AEC-tr-5021) SOME REACTIONS OF NICKEL CARBIDE, Ni_3C, WHICH WAS PREPARED AT LOW TEMPERATURE. H. A. Bahr and Th. Bahr. Translated by L. M. Ferris (Oak Ridge National Lab., Tenn.) from Ber. deut. chem. Ges., 63B: 99-102(1930). 6p.

The nickel carbide obtained by the reaction of CO with metallic Ni at low temperature is a fine black or grey powder which is very pyrophoric. A review of other physical and chemical properties, and reactions is included. (J.R.D.)

13020 (AEC-tr-5044) INVESTIGATIONS ON THE CESIUM−OXYGEN SYSTEM. G. Brauer. Translated for Oak Ridge National Lab., Tenn., from Z. anorg. Chem., 255: 101-24(1947). 40p.

Preparation with a composition between Cs and Cs_2O are prepared by an incomplete oxidation of Cs metal and by charging the oxide Cs_2O with Cs metal. Several intermediate Cs suboxides are identified by measurement of the electrical resistance and its temperature relation as well as by x-ray photographs. A few characteristics of these compounds and of the ordinary oxide Cs_2O are described. The thermal phase diagram given by E. Rengade for the system $Cs-Cs_2O$ can be confirmed in various points, particularly for the cesium-rich mixtures. The observations described do not yet permit a complete evaluation of the Cs-O system in the range between Cs and Cs_2O and the intermediate compounds existing here. (auth)

13021 (HW-tr-33) SUPERCRITICAL WATER AS A SOLVENT FOR ELECTROLYTES. E. U. Franck. Translated by A. B. Johnson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.) from Angew. Chem., 73: 309-22(1961). 44p.

Investigations are discussed in which it was found that supercritical water vapor, when compressed to densities of 0.2 to 0.3 g/ce, takes on electrolytic properties essentially the same as that of liquid water. The dielectric constant of the vapor is sufficiently high to make possible the ionic dissociation of dissolved materials. The significance of supercritical water in mineralogical problems is cited, and the physical and electrical properties of this compound are discussed. Conductivity measurements are described and dissociation constants are given for salts such as KOH, HCl, HF, and NH_3 at 400 to 750°C calculation methods are included for ion products, and hydrolysis constants. (J.R.D.)

13022 (NP-tr-850) ANHYDROUS OXYNITRATES OF TITANIUM AND ZIRCONIUM. V. Gutmann and H. Tannenberger. Translated by M. Tomlinson (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Monatsh. Chem., 87: 421-4(1956). 7p.

The production of anhydrous oxynitrates of titanium and zirconium by conversion of the tetraiodides with dinitrogen tetroxide is described. (auth)

13023 (SCL-T-407) THE COURSE OF SOME POWDER REACTIONS IN THE PREPARATIONS OF LEAD TITANATE. Arnost Bergstein. Translated by Erik Arnhem (Sandia Corp., Albuquerque, N. Mex.) from Chem. listy, 50: 3-10(1956). 16p.

An investigation was conducted to ascertain the effects of chemical composition and crystal structure of initial materials on the reaction in the formation of lead titanate from pressed powder. Resulting data and conclusions are included. (J.R.D.)

13024 (SCL-T-411) ARTIFICIAL REPRODUCTION OF SILLIMANITE (FIBROLITE). Mireille Christophe Michel-Levy. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Compt. rend., 230: 2213-14 (June 19, 1950). 3p.

Sillimanite was reproduced at 450 and 500°C, under a pressure of water vapor amounting to about 50 kg/cm^2, in the presence of sodium borate. Thus, it is not necessarily a mineral of high temperature or high pressure. (auth)

13025 KINETICS OF PARTICLE GROWTH IN A FLUIDIZED CALCINER. B. S. Lee (Polytechnic Inst., Brooklyn), Ju Chin Chu, A. A. Jonke, and Stephen Lawroski. A.I.Ch.E. Journal, 8: 53-8(Mar. 1962).

This study of the factors underlying the mechanisms of particle growth in a fluidized calciner was conducted in a 3-in. diameter column. In such a calciner radioactive waste liquor from nuclear fuel reprocessing can be converted to a granular solid for disposal. To simulate the actual waste, aluminum oxide as bed material and aqueous aluminum nitrate solution as feed were used. Particle growth was traced through the addition of radioactive seeds. The effects on the growth rate of operating variables and physical properties of the feed were investigated. Statistical analysis of the data substantiated the proposed growth mechanism, and the resulting growth coefficient was correlated with the variables studied. (auth)

13026 DIFFUSION OF IDEAL GASES IN CAPILLARIES AND POROUS SOLIDS. D. S. Scott and F. A. L. Dullien (Univ. of British Columbia, Vancouver). A.I.Ch.E. Journal, 8: 113-17(Mar. 1962).

The steady state diffusion of gases through capillaries or through the pores of a solid when the total pressure in the system is constant is considered. It is shown that the ratio of the molar diffusion rate of the lighter gas to that of the heavier gas must be equal to the square root of the ratio of the molecular weight of the heavier to the lighter. From simple momentum transfer considerations a diffusion equation is derived to describe the diffusion rate as the nature of the process changes from ordinary mutual diffusion to Knudsen diffusion. This equation is shown to give good agreement with experimental measurements of diffusion rates in porous solids. A structural parameter of the porous solid, the diffusion ratio, is calculated from the experimental results and compared with the experimental value of the same ratio found from electrical resistance ratios and from flow measurements. (auth)

13027 SPECTRA-STRUCTURE CORRELATIONS IN NUCLEAR SPIN RESONANCES OF FLUORINE-19. E. G. Brame, Jr. (E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). Anal. Chem., 34: 591-2(Apr. 1962).

Correlations of 52 fluorine-containing groups with their chemical shifts were obtained and are tabulated. Variation in the chemical shift for each of the functional groups is a function of the number of different secondary environments of the group in the model compounds examined. The group least rigidly defined, the $CF_2=CF-$ group, has the largest spread. The various kinds of substituents that can be added to CF was seen to affect greatly the position of the $CF_2=CF-$group. The range of chemical shifts in the F^{19} resonance spectra extends over 300 ppm on the scale. Lines attributed to the perfluoromethylene groups are centered at 50 ppm, and those attributed to CF groups are located in the region of 100 ppm. A decrease in the electronegativity results in a shift to high fields, whereas an increase in the electronegativity results in a shift to low fields. Changes in bonding properties through ring strain and unsaturation also affect the chemical shift. (P.C.H.)

13028 PREPARATION OF TRITIUM LABELED PAROMOMYCIN (HUMATIN) BY FERMENTATION IN MEDIUM CONTAINING TRITIATED WATER. Robert E. Ober, Salvatore A. Fusari, George L. Coffey, G. Wayne Gwynn, and Anthony J. Glazko (Parke, Davis Co., Ann Arbor and Detroit, Mich.). Atomlight, No. 22, 3-5(Feb. 1962).

Gram quantities of tritium-labeled, radiochemically pure paromomycin was prepared by fermentation using a medium containing 10 mc of tritiated water per milliliter. The specific activity was about 1 μc/mg of free base and the biological activity was equivalent to that of non-radioactive material. The stability of the label is adequate for tracer experiments in animals. (auth)

13029 PREPARATION OF UNIFORMLY LABELLED C^{14}-SHIKIMIC ACID. M. N. Zaprometov (Timiryazev Inst. of Plant Physiology, Academy of Sciences, Moscow). Biochemistry (U.S.S.R.) (English Translation), 26: 531-4(Jan.-Feb. 1962).

E. coli, strain 83-24, was grown in a medium containing C^{14}-labeled glucose (5 mc). The culture medium was passed through charcoal-celite and ion exchange columns, to give a yield of 885 mg of C^{14}-shikimic acid. The product had a specific radioactivity of 29.000 ipm/mg, or about 0.3 mc/g. In addition, C^{14}-phosphoshikimic acid was isolated from the culture medium, by the same procedure, in a yield of about 300 mg. (auth)

13030 SYNTHESIS OF RADIOACTIVE MEVALONIC ACID AND ITS USE IN THE STUDY OF THE BIOSYNTHESIS OF STEROID GLYCOALKALOIDS FROM SOLANUM. A. R. Guseva, V. A. Paseshnichenko, and M. G. Borikhina (Bakha Inst. of Biochemistry, Academy of Sciences, Moscow). Biochemistry (U.S.S.R.) (English Translation), 26: 631-5(Jan.-Feb. 1962).

The synthesis of 2-C^{14}-mevalonic acid in the form of N,N^1-debenzylethylendiammonium salt is described. It was shown that mevalonic acid is somewhat more incorporated in the aglycones of glycoalkaloids of Solanum than acetate-2-C^{14}. (auth)

13031 THE ABSORPTION SPECTRA OF HNO AND DNO. J. L. Bancroft, J. M. Hollas, and D. A. Ramsay (National Research Council, Ottawa). Can. J. Phys., 40: 322-47(Mar. 1962). (NRC-6683)

The long wavelength $^1A'' - {}^1A'$ transition of HNO and DNO was studied in absorption under high resolution using greater absorption intensities than in earlier work of Dalby. Seven new bands of HNO and 6 of DNO were found and analyzed. Values for ν_1' are: ν_1' (NH) = 2854.17 cm^{-1} and ν_1' (ND) = 2176.49 cm^{-1}. Equilibrium rotational constants A_e', B_e', and C_e' were determined for both molecules. The values for HNO give zero inertial defect, but the values for DNO are less satisfactory, presumably due to resonance between pairs of levels (1, ν_2', ν_3') and (0, $\nu_2' + 1$, $\nu_3' + 1$). Equilibrium values for the geometrical parameters of the excited state and are: $r'_{NH} = 1.02_9 \pm 0.02$ Å, $r'_{NO} = 1.238_3 \pm 0.005$ Å, $\angle HNO = 114° 25' = 2°$. Some of the rotational lines of the (101)-(000) band of HNO are slightly diffuse, the maximum observed line width being ~ 0.7 cm^{-1}.

This observation confirms the predissociation limit and gives a value for the lifetime of the molecule in the excited state, viz $\tau \sim 7.6 \times 10^{-12}$ sec. The predissociation is weak. The possible states causing this predissociation are discussed. (auth)

13032 HIGH RESOLUTION RAMAN SPECTROSCOPY OF GASES. XIV. ROTATIONAL SPECTRA OF C_2H_6, C_2D_6, $C_2H_3D_3$ AND STRUCTURE OF THE ETHANE MOLECULE. B. P. Stoicheff (National Research Council, Ottawa). Can. J. Phys., 40: 358-66(Mar. 1962). (NRC-6700)

An analysis of the rotational Raman spectra of three isotopic species of ethane gave the following for the rotational constants: $B_0(C_2H_6) = 0.6621_5$ cm^{-1}, $B_0(C_2D_6) = 0.4591_5$ cm^{-1}, and $B_0(C_2H_3D_3) = 0.5486_2$ cm^{-1}. It is found that $r_0(C-C) = 1.537_6 \pm 0.003$ Å; and when these values are combined with available values of I_a (the moment of inertia about the symmetric top axis), the CH_3 parameters are $r_0(C-H) = 1.106 \pm 0.006$ Å and $\angle HCH = 108.8 \pm 0.5°$. (auth)

13033 EFFECT OF PRESSURE ON THE MECHANISM AND THE KINETICS OF THE THERMOLYSIS OF HYDRATED THORIUM NITRATE. Bernard Claudel and Yves Trambouze (Faculté des Sciences, Lyon and C.N.R.S., France). Compt. rend., 253: 2950-2(Dec. 18, 1961). (In French)

In the decomposition of hydrated salts, the dehydration is favored by a lowering of the pressure. The decomposition can, on the contrary, be very rapid under atmospheric pressure if, during the dehydration process, the salt melts in its water of crystallization and undergoes, therefore, a hydrolysis. This hydrolysis produces very finely dispersed oxide crystals which catalyse the thermolysis. (tr-auth)

13034 REACTION OF URANIUM HEXAFLUORIDE WITH SOME METAL FLUORIDES. Michel Michallet, Maurice Chevreton, Daniel Massignon, and Charles Eyraud (Faculté des Sciences, Lyon and Centre d'Études Nucléaires, Saclay, France). Compt. rend., 253: 2980-1 (Dec. 18, 1961). (In French)

Uranium and fluorine yield several known compounds, such as UF_4, U_4F_{17}, U_2F_9, UF_5, and UF_6, some of which can be considered as the result of association of uranium ions at different oxidation states. If this hypothesis is true, then it should be possible to obtain addition compounds between uranium hexafluoride and the fluorides of tri- and tetravalent metals. Examples of such compounds with fluorides of Bi, Fe, Al, Sn, Pb, Th, and Ti are given. (auth)

13035 STUDY OF THE REACTION OF POWDERED URANIUM AND CARBON: EFFECT OF THE PREFERENTIAL ORIENTATION OF THE GRAPHITE. Pierre Grégoire (Ecole Centrale des Arts et Manufactures, [France]). Compt. rend., 254: 125-7(Jan. 3, 1962). (In French)

Compression of a mixture of uranium and graphite powder in stoichiometric proportions of the carbide UC strongly orients the graphite. In consequence, during the further reaction, the formation of the carbide UC is accompanied by a very anisotropic variation of the dimensions leading to a volume expansion. On the contrary, the reaction of uranium and amorphous carbon gives place to an isotropic contraction. (tr-auth)

13036 EXPERIMENTAL STUDY OF TRANSITION PROBABILITIES IN ASTRAL RADICALS: LaO (B → X) SYSTEM. N. R. Tawde (Karnatak Univ., Dharwar, India) and P. V. Chandratreya. Current Sci. (India), 30: 137 (Apr. 1961). (In English)

The results of transition probabilities derived from the intensity distribution for the yellow (B → X) system of the LaO molecule are given. Photographic photometry was applied for quantitative estimation of intensities, which were taken as peak values near the band heads. The difference in the internuclear separations of B and X levels of LaO, Δr_e, was previously assigned by others to be 0.038 Å. The values of experimental transition probabilities obtained are tabulated. (P.C.H.)

13037 NUCLEAR MAGNETIC RESONANCE IN COBALT WHISKERS. E. Šimánek (Inst. of Physics, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B 12: 81-3(1962). (In English)

The nuclear magnetic resonance of Co^{59} in Co whiskers at room temperature and in zero applied field was studied using a marginal oscillator for the observation of absorption in about 25 mg of whiskers. Direct oscillographic observation of absorption as a function of frequency was performed using the oscillator grid voltage. Comparing line widths in whiskers and powders, a broadening mechanism of resonance in the hexagonal phase is observed. Whiskers give a hexagonal structure with small lattice strains. This leads to great mobility of Block walls, and intensive signals of nuclear resonance in the hexagonal phase are obtained. (L.N.N.)

13038 NUCLEAR RESONANCE (NMR) STUDIES OF A DEUTERIUM SUBSTITUTED BERYLLIUM COMPLEX. M. A. Rollier, A. Perotti, and S. Meloni (Università, Pavia, Italy). Energia nucleare (Milan), 9: 79-81(Feb. 1962). (In English)

The chelate oxygen complex of beryllium called "basic beryllium acetate" was obtained in the wholly deuterated form and submitted to nuclear resonance investigation. H-D substitution results in the disappearance of the proton resonance in the NMR spectra of carbon tetrachloride solutions of the deuterated complex. Resonance techniques were applied to the study of mixtures of the beryllium complex in the deuterated and hydrogenated forms. (auth)

13039 THE RULES FOR MEAN VALENCE FREQUENCIES OF PYRAMIDAL AND TETRAHEDRAL HYDRIDES AND DEUTERIDES. G. I. Rybakova and V. P. Morozov (Dnepropetrovsk Inst. of Chemistry and Tech., USSR). Izvest. Vysshikh Ucheb. Zavedenií, Fiz., No. 5, 109-14 (1961). (In Russian)

Approximation formulas are derived for expressing the valence frequencies of mixed deutero-replaced pyramidal and tetrahedral hydrides, based on the valence frequencies of non-replaced or totally replaced molecules. The simple relations are developed by applying zero approximations ($\lambda_i \approx D_{ii}$, where D_{ii} are reduced coefficients of total reaction and λ_i are squares of basic frequencies) and are considered the mean rule. (R.V.J.)

13040 STABILITY OF INORGANIC FLUORINE-BEARING COMPOUNDS: II. COMPLEX FLUORIDES. D. L. Deadmore, J. S. Machin, and A. W. Allen (Univ. of Illinois, Urbana). J. Am. Ceram. Soc., 45: 120-2(Mar. 1962).

The thermal stabilities of some alkali and alkaline-earth fluosilicates and cuspidine when heated in atmospheres of dry and moist air were investigated. In the decomposition of K_2SiF_6 the compound K_3SiF_7 was noted. The alkali and alkaline-earth fluosilicates lose SiF_4 whereas cuspidine does not. In moist air, α-cristobalite is found among the residual products from the fluosilicates of sodium and potassium. K_2TiF_6 hydrolyzes, first at low temperatures to an intermediate series of compounds and then at higher temperatures to fluorine-free potassium titanates. Both K_2ZrF_6 and $Na_3Zr_2F_{13}$ hydrolyze to ZrO_2 and the alkali

fluoride by way of an intermediate heptafluoride (M_3ZrF_7). (auth)

13041 BORON HYDRIDES. III. HYDROLYSIS OF SODIUM BOROHYDRIDE IN AQUEOUS SOLUTION. Robert Earl Davis, Edward Bromels, and Charles L. Kibby (Purdue Univ., Lafayette, Ind.). J. Am. Chem. Soc., 84: 885-92 (Mar. 20, 1962).

The hydrolysis of sodium borohydride in aqueous buffer solutions at 25° is catalyzed by general acids. The Brönsted constant is nearly 0.9. Salt effects and solvent isotope effects were measured. A mechanism involving a rate-determining proton transfer from a general acid onto the borohydride ion is consistent with the data of numerous investigators. One reactive intermediate was trapped by hydrolyzing sodium borohydride in aqueous trimethylamine. Trimethylamine borane was produced in 1.45 ± 0.09% yield while the remainder of the borohydride gave hydrogen gas. Hydrolysis of sodium borodeuteride occurs faster than the hydrolysis of sodium borohydride. The primary inverse isotope effect, k_H/k_D, is 0.70 ± 0.02 at 25°. The isotope effect for the boron–hydrogen bond was calculated. Several likely models of the activated complex give values of k_H/k_D from 0.60 to 0.95. A simplified model predicts 0.65 if the amount of primary bond breaking is proportional to the amount of secondary bond stiffening. The possible role of steric effects on secondary hydrogen isotope effects was estimated on a static model. The results show that both normal and inverse secondary isotope effects can be explained in this manner. (auth)

13042 BORON HYDRODES. IV. CONCERNING THE GEOMETRY OF THE ACTIVATED COMPLEX IN THE HYDROLYSIS OF BOROHYDRIDE ION BY TRIMETHYLAMMONIUM ION. Robert Earl Davis (Purdue Univ., Lafayette, Ind.). J. Am. Chem. Soc., 84: 892-4(Mar. 20, 1962).

The rate of hydrolysis of sodium borohydride in aqueous solution at constant pH and constant ionic strength is increased by trimethylammonium ion. The amount of trimethylamine borane produced is much less than the theoretical amount predicted on a four center activated complex. On this basis the four center complex is rejected. Brief discussion is also given on a three center complex. The mean life time of a caged molecular system of borine, hydrogen, and trimethylamine is estimated. (auth)

13043 BORON HYDRIDES. V. METHANOLYSIS OF SODIUM BOROHYDRIDE. Robert Earl Davis and Judith Ann Gottbrath (Purdue Univ., Lafayette, Ind.). J. Am. Chem. Soc., 84: 895-8(Mar. 20, 1962).

The reaction of sodium borohydride with methanol produces hydrogen gas and sodium tetramethoxyboron. The reaction is first order in the borohydride concentration. The addition of acid increases the rate while basic materials such as sodium methoxide and sodium carbonate decrease the rate of methanolysis. At 25°, $-d(BH_4^-)/dt = 1.6 \times 10^7\ (BH_4^-)(CH_3\text{-}OH_2^+) + 1.1 \times 10^{-7}\ (BH_4^-)(MeOH)$ mole l^{-1} sec^{-1}. The data were compared with the data on hydrolysis in aqueous medium. The effect of sodium methoxide upon the methanolysis explains the variable results of previous investigations. With proper control of temperature and basicity, methanol can be used as a medium for reducing ketones to secondary alcohols. The slow addition of one mole of ketone to a basic solution of borohydride gives one mole of alcohol and three moles of hydrogen gas. This is explained in terms of the great reactivity of $(RO)_xBH_{4-x}$ toward methanolysis. (auth)

13044 REACTIONS BETWEEN DEUTERIUM AND OLEFINS IN THE LIQUID PHASE ON PLATINUM OXIDE CATALYSTS. Gerard V. Smith and Robert L. Burwell, Jr. (Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc., 84: 925-34(Mar. 20, 1962).

The liquid phase deuterogenation of 1-hexane, $\Delta^{1,9}$- and $\Delta^{9,10}$-octalin on platinum oxide catalysts was investigated at room temperatures in the liquid phase. The deuterogenation of 1-hexane is accompanied by isomerization to cis- and trans-2-hexene at a rate 3% of that of deuterogenation and by formation of deuteriated hexene of which 90% is 1-hexene at a rate 30% of that of deuterogenation. Most of the saturated product consists of hexane-d_0 to -d_4 with d_{av} about 2.0. Similar isotopic distribution appears in the decalins produced from $\Delta^{1,9}$-octalin (54% cis-, 46% trans-decalin). Exchanged $\Delta^{1,9}$-octalin is formed but no isomerized octalins. These data appear consistent with adsorption of olefin as a vic-diadsorbed species, conversion to mono-adsorbed alkane followed by alternation between mono- and diadsorbed alkane. Isotopic exchange between surface H-atoms and gas phase deuterium is slow relative to desorption of monoadsorbed alkane. $\Delta^{9,10}$-Octalin can be hydrogenated only by adding acetic acid or by prereducing the catalyst in dilute acid. In the latter case the product is 61% cis- and 39% trans-decalin, reaction is slow and d_{av} is nearly 3.0. In all of the trans- and 85% of the cis-decalin, at least three hydrogen atoms were equilibrated with the surface H,D-atom pool in contrast to the situation with $\Delta^{1,9}$-octalin where only two hydrogen atoms were equilibrated in 75% of the product decalins. Most of the cis-and all of the trans-decalin produced from $\Delta^{9,10}$-octalin appear to be derived from a common intermediate in which three hydrogen atoms are equilibrated, possibly $\Delta^{1,9}$-octalin-10-d. (auth)

13045 ELECTROMETRIC STUDIES ON THE PRECIPITATION OF HYDROUS OXIDES OF SOME QUADRIVALENT CATIONS. PART I. PRECIPITATION OF ZIRCONIUM HYDROXIDE FROM SOLUTIONS OF ZIRCONIUM SALTS. R. P. Singh and N. R. Banerjee (Univ. of Delhi). J. Indian Chem. Soc., 38: 865-70(Nov. 1961). (In English)

The precipitation of basic salts and hydroxide of zirconium from solutions of its sulfate, oxychloride, and nitrate was studied. Conductometric and pH titrations of the salt solutions with sodium hydroxide show that the precipitated hydroxide contains appreciable quantities of the anions. Compositions of the basic salts obtained were deduced from the titration curves. Hydrolysis of these salts was found to be a slow process. The increasing order of anion penetration is the same as the co-ordinating power of the respective anions, nitrate, chloride, and sulfate. Titrations of zirconium sulfate solutions against baryta show that the initially precipitated basic sulfate gives up the anion gradually with little change in the pH or the conductance and the ultimate product consists of almost pure hydroxide. (auth)

13046 STUDY ON THE CITRATE COMPLEX OF STRONTIUM. Rabindra K. Pattnaik and S. Pani (University Coll. of Engineering, Burla, [India]). J. Indian Chem. Soc., 38: 896-8(Nov. 1961). (In English)

The citrate complex of strontium was investigated by the pH titration method at pH 7.2 to 7.3. The equilibrium constant of the reaction: $Sr^{2+} + Cit^{3-} \rightleftharpoons SrCit^-$ is determined to be 5.23×10^2. (auth)

13047 EQUILIBRIUM PRESSURES AND PHASE RELATIONS IN THE URANIUM OXIDE SYSTEM. L. E. J. Roberts and A. J. Walter (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 22: 213-29(Dec. 1961). (AERE-R-3345). (In English)

Equilibrium oxygen pressures were directly determined by tensimetric experiments at 1000–1450°C over the composition range $UO_{2.00}$–$UO_{2.30}$. An invariant point was found at 1123 ± 5°, at which the three solid phases UO_{2+x}, U_4C_9 and $UO_{2.61}$ are in equilibrium. The U_4O_9 phase does not extend to compositions richer in oxygen than $UO_{2.25}$ in this temperature range. The tensimetric results are used to construct the relevant parts of the phase diagram and to calculate ΔG, ΔH, and ΔS for the formation of all phases intermediate between UO_2 and U_3O_8 from $UO_{2.00}$. (auth)

13048 A DIFFERENTIAL THERMAL ANALYSIS STUDY OF THE RARE EARTH ETHYL SULPHATES. M. W. Nathans (Univ. of California, Livermore). J. Inorg. & Nuclear Chem., 22: 231-9(Dec. 1961). (UCRL-6280). (In English)

Differential thermal analysis (DTA) curves were obtained for all rare earth ethyl sulfates in a stationary air atmosphere at an upheat rate of about 10°C per min. The effects of particle size, upheat rate, and the conditions of the surrounding atmosphere were investigated. A partial interpretation of the peaks was made by a modified thermogravimetric method method and other analytical means. The decomposition of the salts follows more or less the following general pattern: $M(C_2H_5SO_4)_3 \cdot 9H_2O$ $M(C_2H_5SO_4)_3 \cdot 5H_2O \rightarrow M(C_2H_5SO_4)_3$ $M(HSO_4)_3 \rightarrow$ intermediates $\rightarrow M_2(SO_4)_3$, where M represents any rare earth metal. The first three steps all occur below 200°. The last step is certainly completed at 500°. The intermediates are possible double salts of the sulfates and the bisulfates or have the composition $pM_2(SO_4)_3 \cdot qH_2SO_4$. The dehydration and the decomposition of the organic radical have activation energies of the order of 12 and 16 kcal/mole, respectively. The bisulfate decomposition may have an activation energy of something like 8.5 kcal/mole. The reactions are first order, with one exception, which appears to be of fractional order. (auth)

13049 EXCHANGE PROPERTIES OF AMMONIUM SALTS OF 12-HETEROPOLYACIDS. III. THE SORPTION OF STRONTIUM AND YTTRIUM ON AMMONIUM PHOSPHOTUNGSTATE AND THEIR SEPARATION FROM CAESIUM. J. Krtil (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez and Prague). J. Inorg. & Nuclear Chem., 22: 247-51(Dec. 1961). (In English)

Both the static and dynamic sorption and elution of Sr and Y on ammonium phosphotungstate (NH_4PW) were studied, and conditions for the separation of Sr and Y from Cs were determined. It was found that both Sr and Y may be separated from Cs by sorption on NH_4PW or on a column filled with asbestos, followed by elution with various electrolytes. Sr and Y may also be separated by sorption from neutral and acid solutions followed by elution. (P.C.H.)

13050 THE KINETICS OF ION EXCHANGE ON ZIRCONIUM PHOSPHATE AND HYDRATED THORIA. G. H. Nancollas and R. Paterson (Univ. of Glasgow). J. Inorg. & Nuclear Chem., 22: 259-68(Dec. 1961). (In English)

The rates of sodium–hydrogen exchange on thoria and on zirconium phosphate in two particle sizes were measured both by titration and potentiometrically in limited bath experiments over a sodium ion concentration range 0.01–1.0 M. The rate is independent of sodium ion concentration within this range, and the results indicate that the rate controlling process is the diffusion of ions through the exchanger particles. Further evidence in support of particle diffusion is afforded by infinite bath cesium–potassium exchange experiments on zirconium phosphate using a tracer technique. The effective diffusion coefficient for the sodium and hydrogen ions in the thoria exchanger ranges from about $4-15 \times 10^{-8}$ cm^2-sec. (auth)

13051 THE ADSORPTION OF MONOVALENT AND DIVALENT CATIONS BY DIALLYL PHOSPHATE AND STYRENE METHYLENE PHOSPHONATE POLYMERS. J. Kennedy, J. Marriot, and V. J. Wheeler (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 22: 269-77(Dec. 1961). (In English)

The adsorption of monovalent and alkaline earth cations by ionic phosphorylated resins was investigated. Adsorption sequences under acidic conditions are Li < Na < K < Rb < Cs ≪ Ag and Sr < Ca ≪ Be, and with dibasic resins in alkaline media Na > K > Rb. The sequences for the alkali metal cations are in accord with those obtained by other investigators. (auth)

13052 MOLECULAR WEIGHT STUDIES OF SEVERAL ORGANOPHOSPHORUS ACIDS. J. R. Ferraro, G. W. Mason, and D. F. Peppard (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 22: 285-91(Dec. 1961). (In English)

Molecular weight studies of several organophosphorus acids of the types $(GO)_2PO(OH)$, $(GO)G'PO(OH)$, and $(GO)PO(OH)_2$ were made in several solvents, using an isothermal distillation method. In general, the monobasic acids are dimers in solvents such as n-hexane, cyclohexane, benzene, and carbon tetrachloride; monomers in methyl alcohol; and intermediate in chloroform and acetone. Mono-(2-ethylhexyl)phosphoric acid is highly polymeric in n-hexane and cyclohexane, the molecular weight being 8–14.5 times the formula weight; hexameric in benzene and carbon tetrachloride; dimeric in acetone; and monomeric in methyl alcohol. The change in state of aggregation, for both the mono and dibasic acids, as the diluent is varied, parallels the predicted variation in solute-solvent interaction. (auth)

13053 LIQUIDUS RELATIONS IN THE SYSTEM LITHIUM METAPHOSPHATE–LITHIUM PYROPHOSPHATE. M. M. Markowitz, R. F. Harris, and W. N. Hawley (Foote Mineral Co., West Chester, Penna.). J. Inorg. & Nuclear Chem., 22: 293-6(Dec. 1961). (In English)

Lithium metaphosphate and pyrophosphate are suggested as possible components for fused salt nuclear breeder blankets because of the relatively high thermal stability of these compounds and of the very low absorption of thermal neutrons exhibited by phosphorus. The phase system $LiPO_3$–$Li_4P_2O_7$ was studied by means of high temperature microscopy and differential thermal analysis. At liquidus temperatures, the system was determined to be of the simple eutectic type with the eutectic at 84.5 mole % $LiPO_3$ and 603°. An arrest occurring at 569° might indicate the existence of a polyphosphate higher than the pyrophosphate in the solidus region; however, the origin of this halt was not identified. The $LiPO_3$–$Li_4P_2O_7$ system in contrast to other metaphosphate–pyrophosphate systems appears to be unique due to the absence of higher polyphosphates in the liquidus region. (auth)

13054 INFRARED SPECTRA AND FORCE CONSTANTS OF CH_2Cl_2, $CHDCl_2$, AND CD_2Cl_2. Takehiko Shimanouchi and Isao Suzuki (Tokyo Univ.). J. Mol. Spectroscopy, 8: 222-35(Mar. 1962).

Deuterated dichloromethanes, $CHDCl_2$ and CD_2Cl_2, were prepared. Their infrared spectra were measured in the gaseous and liquid states and were compared with those of CH_2Cl_2. The assignments of bands were made. From these frequencies, the simple Urey-Bradley force constants, the

modified Urey-Bradley force constants, and the general quadratic potential force constants were calculated. The importance of the correction term $(\Delta\alpha)(\Delta\alpha')$ was noticed. From the calculated values of the L_{cc}-matrix the modes of normal vibrations were determined. (auth)

13055 KINETICS OF THE VANADIUM(III)–NEPTUNIUM(V) REACTION IN PERCHLORATE SOLUTIONS. E. H. Appelman and J. C. Sullivan (Argonne National Lab., Ill.). J. Phys. Chem., 66: 442-5(Mar. 1962).

The kinetics of the reaction V(III) + Np(V) → V(IV) + Np(IV) were studied in perchloric acid solutions. The empirical form of the rate law is $-d[Np(V)]/dt = [Np(V)][V(III)](k_1 + k_2^0[Np(IV)][V(IV)]^{-1}[H^+]^{-1.5})$. At 25°, in $LiClO_4$-$HClO_4$ solutions 3.0 M in total perchlorate, $k_1 = 0.30$ M^{-1} sec^{-1}, and $k_2^0 = 0.16$ $M^{0.5}$ sec^{-1}. Under these conditions, for the k_1 path $\Delta H^* = 14.6 \pm 0.8$ kcal/mole and $\Delta S^* = -12.3 \pm 2.6$ eu. The second term of the rate law was interpreted in terms of the rapid equilibrium Np(IV) + V(III) ⇌ Np(III) + V(IV) followed by the reaction Np(III) + Np(V) → 2Np(IV). A comparison was made between the mechanisms of this and analogous reactions. (auth)

13056 AN ISOTOPIC EXCHANGE METHOD FOR MEASURING THE SURFACE AREA OF SUPPORTED TRANSITION METAL SULFIDES. H. R. Lukens, Jr., R. G. Meisenheimer, and J. N. Wilson (Shell Development Co., Emeryville, Calif.). J. Phys. Chem., 66: 469-70(Mar. 1962).

Specific surface areas of supported metal sulfides were measured by means of the exchange between normal sulfur atoms of the metal sulfides and radioactive sulfur atoms of S^{35}-tagged H_2S. Each determination was carried out in liquid scintillation solution containing a weighed amount of insoluble metal sulfide and a known amount of dissolved H_2S (S^{35}). The disappearance of S^{35} from solution due to exchange with solid was followed by liquid scintillation counting until equilibrium was established. (auth)

13057 TUNNELLING CORRECTIONS FOR UNSYMMETRICAL ECKART POTENTIAL ENERGY BARRIERS. Harold S. Johnston and Julian Heicklen (Univ. of California, Berkeley). J. Phys. Chem., 66: 532-3(Mar. 1962).

Tunnelling corrections were evaluated for the unsymmetrical Eckart potential for ranges of parameters expected for ordinary chemical reactions at ordinary temperatures. (auth)

13058 IONIZATION CONSTANT OF 2,2'-DIHYDROXYBIPHENYL IN LIGHT AND HEAVY WATER. John E. Gordon and S. L. Johnson (Melton Inst., Pittsburgh). J. Phys. Chem., 66: 534-6(Mar. 1962).

The first ionization constant of 2,2'-dihydroxybiphenyl was measured in light and heavy water at 25°, giving the values of $pK_1^H = 7.56$ and $K_1^H/K_1^D = 6.34$. K_1^H/K_2^H is estimated to be 10^6 or greater. This large isotope effect on pK_1 and the large separation between pK_1^H and pK_2^H reflect the formation of a strong hydrogen bridge in the monoanion. (auth)

13059 SOLUBILITIES OF SOME STRONG ELECTROLYTES IN THE HYDROGEN PEROXIDE–WATER SYSTEM. II. RUBIDIUM AND CESIUM NITRATES. Martin E. Everhard and Paul M. Gross, Jr. (Univ. of Virginia, Charlottesville and Wake Forest Coll., Winston Salem, N. C.). J. Phys. Chem., 66: 548-9(Mar. 1962).

Solubilities of $RbNO_3$ and $CsNO_3$ were examined as well as the nature of the solid phases in equilibrium with these systems in order to study the possible role of cation size. The formation of hydroperoxidates and the increase in solubility of the salts with larger cations in hydrogen peroxide-rich solutions indicate preferential solvation of the ions by H_2O_2 rather than by H_2O. Conversely, the formation of hydrates and lower solubility in hydrogen peroxide-rich solutions of the smaller cation salts indicate preferential solvation of the ions by water. The deviation of the molal solubility, M', of the alkali nitrates in H_2O_2 from that in H_2O ($M_{H_2O_2}$ minus M_{H_2O}) at 25° was found to follow the straight line $M' = 33.5\ r - 39.7$ (± 0.03 in M'), where r is the radius of the cation. $CsNO_3$, however, did not fall on the line, which probably is due to the lower charge density of the cesium ion. (P.C.H.)

13060 THERMOLUMINESCENCE OF GOLDEN SAPPHIRE AND FUSED BORAX SEEDED WITH Ni, Mg, AND UO_3. H. A. Woodbury, H. Eyring, and A. F. Gabrysh (Univ. of Utah, Salt Lake City). J. Phys. Chem., 66: 551-4(Mar. 1962).

Thermoluminescence of golden sapphire (Al_2O_3 containing Ni and Mg impurities) was compared to a sample of soda boron oxide glass containing a small amount of nickel, then to a sample containing magnesium, and finally to a sample containing both nickel and magnesium. A comparison also was made of glow curves for various weight percents of UO_3 as the network modifier in the glass structure. Thermoluminescence glow curves were produced after gamma irradiation for samples of fused borax glass seeded with Ni, Mg, and UO_3. All of the thermoluminescence peaks were reproducible after successive irradiations and were found to lie in one of three ranges; 80°K, 168 ± 5°K, and 228 ± 5°K. After many irradiations at liquid nitrogen temperatures and annealing to room temperature, the sample containing only Ni showed an increase in the intensity for the 228°K peak. The glow curves for single crystalline golden sapphire showed characteristics different from the Ni and Mg seeded glass samples. The thermoluminescence peaks showed a decrease with cumulative and successive 30 min irradiations, and the peaks occurred at slightly increased temperatures. (P.C.H.)

13061 TRANSLATIONAL ENERGY ACCOMMODATION IN THE NICKEL–CHLORINE SURFACE REACTION. J. D. McKinley (National Bureau of Standards, Washington, D. C.). J. Phys. Chem., 66: 554-6(Mar. 1962).

A method for measuring the transfer of translational energy in gas-surface collisions is described. Mass spectrometric measurements were made of a collimated beam of unreacted chlorine reflected from the nickel surface at temperatures between 1100 and 1600°K. By a simple modification of the mass spectrometer ion source, it was possible to measure the flux and density of the beam. In the chlorine–nickel reaction it was found that from 20 to 40% of the chlorine reacts on the surface to form NiCl or $NiCl_2$, while the remaining chlorine is reflected without reacting and without a measurable gain in translational energy. The results indicate that very little translational energy is transferred during the one collision that the chlorine molecule makes with the reacting surface. (P.C.H.)

13062 IONIC TRANSPORT AND THE CRYSTALLOGRAPHIC TRANSITION IN CESIUM CHLORIDE. I. M. Hoodless and J. A. Morrison (Univ. of Glasgow and National Research Council, Ottawa). J. Phys. Chem., 66: 557-9(Mar. 1962).

An investigation was made of the ionic motion in the transitional region by measuring self-diffusion of the chloride ion in CsCl and by measuring the conductivity of a single crystal. The results indicate an absence of any enhanced diffusion in the pretransition region, which

shows clearly that the transition from the bcc form to the fcc form occurs without the formation of a large excess of lattice vacancies. Therefore, it is felt that the transformation does not involve an extensive disruption of the lattice but rather a simple change such as dilatation. (P.C.H.)

13063 MISCIBILITY OF METALS WITH SALTS. VI. LITHIUM–LITHIUM HALIDE SYSTEMS. A. S. Dworkin, H. R. Bronstein, and M. A. Bredig (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 66: 572-3(Mar. 1962).

Studies were made of the miscibility of Li, Na, K, Rb, and Cs in lithium halides. The regular trend in the miscibility of the alkali metals with their molten fluorides was found: a rapid increase in miscibility with increase in atomic number of the alkali metal. The solubility of Li in LiCl was found to increase from a value of 0.5 ± 0.2 mole % at 640° to 2.0 ± 0.2 mole % at 1000°. The solubility of Li in LiI increased from a value of 1.2 ± 0.5 mole % at 550° to 2.5 ± 0.5 mole % at 950°. The values were the lowest found among the alkali metal solubilities in their chlorides and iodides. (P.C.H.)

13064 SUPERFINE PARTICLE MAGNETITE. Shizuo Fujiwara and Yuzuru Fujiwara (Tokyo Univ.). J. Phys. Soc. Japan, 17: 405(Feb. 1962). (In English)

Superfine particle magnetites were prepared in cross-linked polyvinylalcohol (PVA) media. PVA gel prepared by Co^{60} gamma irradiation was immersed in a mixed aqueous solution of ferric and ferrous chlorides and then in sodium hydroxide. Measurements of Fe_3O_4 concentration, residual magnetization, and coercive force were made. Data are presented in tabular form. (L.N.N.)

13065 USE OF SODIUM CHLORIDE IN THE CHLORINATION OF COLUMBITE & ILMENITE. B. S. Mathur, V. S. Sastri, and Y. W. Gokhale (Atomic Energy Establishment, Trombay, India). J. Sci. Ind. Research (India), 21D: 5-7(Jan. 1962).

The use of sodium chloride in the separation of the economic constituents of columbite and ilmenite by chlorination is described, and the optimum conditions for chlorination were determined. The addition of alkali chloride in the chlorination process was found to be advantageous since it complexes iron and uranium to form non-volatile double salts, thus rendering an enrichment of the main values in the volatiles. (auth)

13066 DETERMINATION OF ENTHALPY CHANGE OF OXIDATION REACTION OF URANIUM DIOXIDE BY D.T.A. Toshio Uchijima, Keiji Naito, and Takashi Mukaibo (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 111-17(Feb. 1962). (In English)

Measurement of the heat of oxidation of UO_2 was carried out by differential thermal analysis (DTA). The values of ΔH, thus obtained, were as follows, for $UO_2 + \frac{1}{6} O_2 \rightarrow \frac{1}{3} U_3O_7$, $\Delta H_1 = -13.8 \pm 1.5$ kcal/mol (230°C) and for $\frac{1}{3} U_3O_7 + \frac{1}{6} O_2 \rightarrow \frac{1}{3} U_3O_8$, $\Delta H_2 = -10.8 \pm 1.3$ kcal/mol (380°C). In addition, a preliminary experiment on the specific heat measurement of UO_2 resulted in $\Delta H_1 = -12.8$ kcal/mol (230°C) and $\Delta H_2 = -11.0$ kcal/mol (380°C). These are in good accordance with the DTA results. Some considerations on the availability of DTA method for calorimetry are also given. (auth)

13067 SORPTION OF XENON IN HIGH DENSITY GRAPHITE AT HIGH TEMPERATURES. Frank J. Salzano and Allen M. Eshaya (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 12: 1-3(Jan. 1962). (BNL-5075-R)

The quantities of xenon taken up by type R-4 high density graphite in contact with xenon gas at 750 and 1000°C were measured. A technique was developed whereby graphite at high temperature was equilibrated with xenon containing active tracer and the sample quenched in cold mercury to seal in the sorbed gas. It was determined that at these high temperatures there is no appreciable surface adsorption and that the major portion of the xenon in the graphite is contained in the interconnected pores. The quantity of gas held could be expressed by the ideal gas law if the void volume per gram of graphite and the partial pressure of the xenon were known. As a result of this work an explanation is offered for the high concentrations of fission xenon found in graphite surfaces in contact with a neutron irradiated solution of uranium in bismuth. (auth)

13068 OXIDATION AND HEAT TRANSFER STUDIES IN GRAPHITE CHANNELS. I. THE EFFECT OF AIR FLOW RATE ON THE $C-O_2$ AND $CO-O_2$ REACTIONS. Donald G. Schweitzer, George C. Hrabak, and Robert M. Singer (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 12: 39-45(Jan. 1962). (BNL-5303)

When air is passed through a hot graphite channel, the heat produced by the chemical reactions is due to both the $C-O_2$ and $CO-O_2$ reactions. The data show that the largest and most rapid temperature rises are due to the $CO-O_2$ gas phase reaction. Serious instability (where the heat generated by the reactions is greater than the heat removed by the air stream) does not occur below 650°C and is confined to flow rates where the Reynolds numbers lie between 2000 and 8000. Although the experiments were designed to provide information for operation of the BNL Reactor, the results were found to be general in nature. (auth)

13069 OXIDATION AND HEAT TRANSFER STUDIES IN GRAPHITE CHANNELS. II. THERMAL CHANGES WITH TIME AND DISTANCE IN AIR-COOLED GRAPHITE CHANNELS. Donald G. Schweitzer and David H. Gurinsky (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 12: 46-50(Jan. 1962). (BNL-5304)

In an air-cooled graphite channel in which heat is being generated by oxidation, the length of channel cooled is a function of the heat transfer coefficient. No diameter effect other than that accounted for by the heat transfer coefficient was observed. Cooling rates and temperature differences (between the graphite and air) vary very slowly in the cooled section of the channel. Temperature changes vary rapidly with time in the section of channel in which more heat is generated than is removed by the air stream. These changes do not affect the cooled section of channel. (auth)

13070 OXIDATION AND HEAT TRANSFER STUDIES IN GRAPHITE CHANNELS. III. THE CHEMICAL REACTIVITY OF BNL GRAPHITE AND ITS EFFECT ON THE LENGTH OF CHANNEL COOLED BY AIR. Donald G. Schweitzer and Robert M. Singer (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 12: 51-8(Jan. 1962). (BNL-5305)

Thermal equilibria between the heat produced by graphite oxidation and the heat removed by coolant air streams were investigated in the temperature range from 650 to 735°C. The studies were made on graphite channels whose reactivities differed by a factor of eight. Equilibrium occurs in channels shorter than 10 ft if the numerical value of the reactivity (cal/cm^2-sec) is 100-fold greater than the heat transfer coefficient (cal/cm^2-sec-°C). The length of channel cooled depends on the heat transfer coefficient and is insensitive to the reactivity when the heat transfer coefficient is numerically equal to or greater than the reactivity of the graphite. (auth)

13071 OXIDATION AND HEAT TRANSFER STUDIES IN GRAPHITE CHANNELS. IV. COMBINED EFFECTS OF TEMPERATURE, FLOW RATE, DIAMETER, AND CHEMICAL REACTIVITY ON THE LENGTH OF CHANNEL COOLED BY AIR. Donald G. Schweitzer (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 12: 59-62(Jan. 1962). (BNL-5523)

The activation energy for graphite oxidation was obtained from the change in the stable length of channel with temperature. The maximum temperature at which thermal equilibrium (between the heat generated by graphite oxidation and the heat removed by the air stream) will occur in a channel can be predicted from the heat transfer coefficient, the activation energy, and a single value of the graphite reactivity at any temperature. Above this maximum temperature, the total length of channel is thermally unstable. An equation is given expressing the length of channel that can be cooled as a function of temperature, flow rate, diameter, and reactivity. (auth)

13072 FISSION PRODUCT TRAPPING–SORPTION OF CESIUM BY ACTIVATED CHARCOAL. E. E. Anderson, G. L. Wessman, and L. R. Zumwalt (General Dynamics Corp., San Diego, Calif.). Nuclear Sci. and Eng., 12: 106-10(Jan. 1962). (GA-1882)

High-temperature, gas-cooled, graphite-moderated reactors such as the HTGR feature continuous removal of volatile fission products by, and their subsequent trapping from, a helium purge stream. Cesium is a volatile fission product of considerable interest; therefore, an investigation of the specific sorption (gm Cs/gm C) of activated charcoal as a function of temperature and pressure was undertaken. The experimental approach was to use Cs^{137}-tagged metal of known specific activity whereby the amount of cesium sorbed on charcoal could be determined in situ by a calibrated gamma spectrometer system. Cesium adsorption on activated charcoal was found to follow the Freundlich adsorption equation. Isosteric heats of adsorption are given as functions of specific adsorption. The free energy of adsorption was found to be a linear function of the specific adsorption only, thus leading to a method of determining the adsorption isobars and isotherms from a minimum of data. (auth)

13073 ELECTRON SPIN RESONANCE IN TWO SALTS CONTAINING GADOLINIUM. J. M. Baker and F. I. B. Williams (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 78: 1340-52(Dec. 15, 1961).

The electron spin resonance spectra of Gd^{3+} were measured in gadolinium hexa-antipyrene iodide (HAPI), lanthanum HAPI, and cadmium fluoride. In CdF_2 the Gd^{3+} ions are sometimes in sites of cubic and sometimes in sites of tetragonal symmetry. In the latter the zero field splitting is remarkably small, being about 0.05 cm^{-1}. In the HAPI there is a large zero field splitting, about 0.98 cm^{-1} overall, and even in the undiluted salt the line width is only about 230 gauss, so that it may be suitable for a zero field maser. The problem of rotation of the frame of reference in which the crystal field is described so that the spin Hamiltonian may be written in a form diagonal in the applied magnetic field is discussed. The coefficients were tabulated for the polynomials involved in the general rotation matrix for the operator equivalents. The polynomials were plotted as a function of the angle. Factors related to untabulated matrix elements of the operator equivalents to the Wigner 3-j symbols are presented. (auth)

13074 ELECTRON SPIN RESONANCE IN TWO GROUPS OF LANTHANON SALTS. J. M. Baker and R. S. Rubins (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 78: 1353-60(Dec. 15, 1961).

Electron spin resonance measurements were performed on lanthanon ions in the hexa-antipyrene iodide (HAPI) salts and also in lanthanum trifluoride. At room temperature the HAPI have trigonal symmetry with one lanthanon ion per unit cell, but at low temperatures, there is a change of crystal structure. For all ions except Ce^{3+} and Gd^{3+}, electron spin resonance is observed only at temperatures below the transition. The lanthanon ion in the HAPI at low temperatures and in the trifluoride have rhombohedral point symmetry and there are several ions in the unit cell. Not all ions with Kramers degeneracy exhibited resonance in both salts, and the few non-Kramers cases investigated also exhibited no resonance. In both salts, the most extensive measurements were made on Ce^{3+}. In the HAPI, Ce^{3+} has a remarkably long relaxation time, and the spectrum is visible at 90°K. The measurements on Ce^{3+} in LaF_3 are correlated with theoretical discussion. (auth)

13075 RELATIONSHIP BETWEEN THE ACTIVATION ENERGIES FOR DEUTERIUM OXIDE DIFFUSION AND EXCHANGEABLE ION CONDUCTANCE IN CLAY SYSTEMS. Gordon R. Dutt and Philip F. Low (Purdue Univ., Lafayette, Ind.). Soil Sci., 93: 195-203(Mar. 1962).

Diffusion coefficients and the corresponding activation energies for the diffusion of D_2O through Li-, Na-, and K-clay pastes were determined at different temperatures. The activation energies were 4.9 kcal per mole in the Li-clay and 4.0 kcal per mole in both the Na- and K-clays. Since the activation energy for D_2O diffusion in pure water is 4.6 kcal per mole, it was postulated that the water was more viscous than normal water in the Li-clay but less viscous than normal water in the other two clays. Since a direct-current method was used to measure the specific conductances of the Li-, Na-, and K-clay pastes at different temperatures, the activation energies for the migration of these ions could be determined. These activation energies were of comparable magnitude to those for D_2O diffusion in these clay pastes. It was shown that negligible electro-osmosis occurred during the conductance experiments. It was concluded, therefore, that the rate of exchangeable ion migration is governed by the rate at which the adsorbed water molecules jump from one equilibrium position to the next. The rate of ionic diffusion should be governed similarly. (auth)

13076 KINETICS OF THE EXCHANGE REACTION $CD_3 + CD_4 \rightarrow CD_4 + CD_3$ USING ^{14}C AS TRACER. G. A. Creak, F. S. Dainton, and K. J. Ivin (Univ. of Leeds, Eng.). Trans. Faraday Soc., 58: 326-32(Feb. 1962).

The ratio of the rate constants for the abstraction of a deuterium atom by a CD_3 radical from $C^{14}D_4$ and $(CD_3)_2CO$ in the gas phase was determined at five temperatures in the range 200 to 350°C. It was concluded that for the reaction $CD_3 + C^{14}D_4 \rightarrow CD_4 + C^{14}D_3$, $\log_{10} k$ (l. $mole^{-1}$ sec^{-1}) = $9.6 - 17.8 \pm 0.5$ kcal $mole^{-1}/2.303$ RT. The result is discussed in relation to the reaction $CH_3 + C^{14}H_4 \rightarrow CH_4 + C^{14}H_3$ and to isotope effects in other gaseous hydrogen-atom transfer reactions. (auth)

13077 SATURATED VAPOR PRESSURE OVER LIQUID LANTHANIDE CHLORIDES AND $LnCl_3$–KCl WHERE Ln IS La, Ce, Pr, AND Nd. G. I. Novikov and A. K. Baev (Odessa State Univ., USSR). Zhur. Obshchei Khim., 32: 315-16(Jan. 1962). (In Russian)

The vapor pressures over molten La, Ce, Pr, and Nd chlorides were measured at 1124 to 1220, 1093 to 1224, 1041 to 1192, and 962 to 1194°C, respectively. The saturated vapor pressure was also measured over molten

binary compounds of the lanthanide chlorides with potassium chloride. The results are tabulated. (R.V.J.)

13078 TRANSACTIONS OF THE SYMPOSIUM ON ELECTRODE PROCESSES. Ernest Yeager, ed. Papers Presented at a Symposium of th Theoretical Electrochemistry Division of the Electrochemical Society in Philadelphia, on May 4 to 6, 1959. The Electrochemical Society Series. New York, John Wiley & Sons, Inc., 1961. 384p.

Eighteen papers are presented on double layer phenomena and correlation with electrode processes, metal deposition and dissolution, and fast electrode reactions. Transposition of methods of chemistry to electrochemistry is discussed in terms of the determination of reaction orders and of application to electrode kinetics of molecular models for charge transfer reactions in solution. The electrochemical ultrasonic effects in electrode systems are also discussed. Information is also presented on hydrogen over-voltage, adsorption of electrodes, and transient methods for the study of metal deposition. (N.W.R.)

13079 METHOD AND APPARATUS FOR DETERMINING AMALGAM DECOMPOSITION RATE. R. W. Johnson and C. C. Wright (to U. S. Atomic Energy Commission). U. S. Patent 3,031,385. Apr. 24, 1962.

A method and apparatus for measuring the rate at which an amalgam decomposes in contact with aqueous solutions are described. The amalgam and an aqueous hydroxide solution are disposed in an electrolytic cell. The amalgam is used as the cathode of the cell, and an electrode and anode are disposed in the aqueous solution. A variable source of plating potential is connected across the cell. The difference in voltage between the amalgam cathode and a calibrated source of reference potential is used to control the variable source to null the difference in voltage and at the same time to maintain the concentration of the amalgam at some predetermined constant value. The value of the current required to maintain this concentration constant is indicative of the decomposition rate of the amalgam. (AEC)

Radiation Chemistry and Radiochemistry

13080 (CEA-2072) UNE INSTALLATION DE PREPARATION DE RADIOELEMENTS PAR EFFET SZILARD-CHALMERS. (An Installation for the Preparation of Radioelements using the Szilard-Chalmers Effect). Michel Douis and Jean Valade (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 40p. (SRE/PR-7)

In the high-activity laboratories at Saclay is built a single block grouping all the Szilard-type apparatus, as well as facilities for storage, decanning of the irradiated products, and distribution of the final solutions. The radioelements prepared in this installation include Cr^{51}, As^{76}, Zn^{65}, Cu^{64}, and Fe^{55}-Fe^{59}. The installation is described, and the chemical methods used are outlined. (auth)

13081 (HW-72114) FISSION-INDUCED VAPORIZATION OF UO_2 FROM A SOURCE AND SUBSEQUENT CONDENSATION ON COLLECTORS EXPOSED TO FISSION FRAGMENT BOMBARDMENT. T. K. Bierlein and B. Mastel (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1961. Contract AT(45-1)-1350. 14p.

Experiments were carried out to establish that UO_2 in the immediate vicinity of a moving fission fragment does vaporize from the fission source film. The deposit which condenses on collectors during vacuum irradiations was identified as UO_2. Moreover, long fission fragment tracks in the collector were attributed to fission fragments originating from the deposit on the collector. A 200-A-thick amorphous coating of carbon on the surface of UO_2 fission source films greatly reduced the vaporization. Three types of collectors—amorphous carbon, amorphous carbon with a thin coating of platinum, and large grained aluminum—displayed holes and tracks after bombardment with fission fragments from carbon-coated UO_2 sources. Fission fragment damage in these targets differs in track geometry and in the amount and uniformity of material ejected. (auth)

13082 (MLM-1118) MOUND LABORATORY PROGRESS REPORT [ON RESEARCH] FOR AUGUST 1961. J. F. Eichelberger (Mound Lab., Miamisburg, Ohio). August 31, 1961. Contract AT(33-1)-Gen-53. 19p.

Data are tabulated on developmental adhesive formulations. Concentration of on-hand Pa in sulfuric acid is reported and data on selective adsorption of trace elements on metal and glass surfaces is given. A method is being developed for determining the coincidence correction in proportional counters by following the decay of 36-min Pb^{211} produced in Ac^{227} decay. Development of the 4 π counting analytical system is reported, and improvements to microcalorimeters are described. Developments in emission spectroscopy and gas chromatography are reported. Research on physical and thermal properties of fuels is discussed and diffusion of Pu in Ni is examined. Preparation and properties of Pu-bearing glass systems are examined. (J.R.D.)

13083 (NYO-9420) A COMPARISON OF RADIATION-INDUCED GRAFT COPOLYMERIZATION UTILIZING ELECTRON ACCELERATORS AND ISOTOPE SOURCES AS RADIATION INITIATORS. Final Report, July 18, 1960—October 17, 1961. George Odian, William F. Oliver, Lawrence J. Friedman, Terese Acker, Earl Pierre, John Foltin, and Elliot Ratchik (Radiation Applications Inc., Long Island City, N. Y.). Nov. 7, 1961. Contract AT(30-1)-2636. 29p.

An 1100-curie Co^{60} source, a 1.0-Mev Dynamitron electron accelerator and a 2.0-Mev Van De Graaff electron accelerator were used in an investigation of the radiation-induced graft copolymerization of a methacrylic acid-styrene (2:1 mole ratio) mixture onto polypropylene. A qualitative analysis of the graft copolymer composition, based on spectroscopic analyses and on the dyeability of the grafted samples indicated that isotope initiated grafts are richer in the more polar component than equivalent accelerator initiated copolymer grafts. A study of film thickness effects on the grafting rate revealed that at high Co^{60} dose rates and at accelerator dose rates this grafting process is mainly taking place at the polymer surface. Gamma radiation-induced surface graft copolymerizations of styrene-acrylonitrile and of styrenemethyl acrylate to Teflon were studied. It was observed that the compositions of the various grafted copolymers are richer in the more polar monomer than would be predicted from the Lewis-Mayo copolymer composition equation. These results were interpreted in terms of a preferential solvation of the relatively immobile growing graft polymer free radicals by the polar monomers. A brief examination of the post irradiation grafting of machine irradiated polyethylene film with acrylic acid monomer was made. Evidence of postgrafting was detected in samples that had been irradiated to a total dose of 10 Mrads at a dose rate of 0.01 Mrad/sec and then exposed

to a 25% purified acrylic acid solution in benzene for periods of 1 to 4 days. (auth)

13084 (NYO-9830) A STUDY OF THE MECHANISM OF RADIATION-INDUCED GELATION IN MONOMER–POLYMER MIXTURES. Quarterly Summary Report, August 1, 1961–October 31, 1961. George Odian, Bruce S. Bernstein, and James J. Kelly (Radiation Applications Inc., Long Island City, N. Y.). Nov. 8, 1961. Contract AT(30-1)-2816. 32p.

Gel contents can be obtained with polyethylene swollen with inhibitor-free allyl acrylate or inhibitor-free allyl methacrylate at a dose of only 0.05 Mrads. Using Co^{60} as the radiation source, allyl methacrylate gives higher gel content than allyl acrylate under similar conditions. Monomer desorption after a dose of 0.05 Mrads is significant and continues after Co^{60} irradiation has been completed. Monomer desorption after a dose of 1.2 Mrads is less than after 0.05 Mrads, and does not continue after irradiation is stopped. Gel contents can be obtained without prior equilibrium swelling of polymer–monomer mixtures by irradiating the polymer in the presence of the monomer in a nitrogen atmosphere. By irradiating under these conditions with prior equilibrium swelling, gel fractions appear to be higher than those normally obtained. Gel contents of irradiated equilibrium-swollen polyethylene/allyl acrylate and polyethylene/allyl methacrylate increase with increasing radiation dose from 0.05 to 1.2 Mrads. Gel contents of 1.2 Mrad irradiated polyethylene-allyl methacrylate systems containing various initial amounts of monomer, increase with increasing monomer content. Polypropylene can be radiation crosslinked to give over 40% gel by prior equilibrium swelling with allyl acrylate or allyl methacrylate. (auth)

13085 (TID-15251) THE EFFECT OF ELECTROPHILIC ADDITIVES ON THE RADIOLYTIC PRODUCTS OF ORGANIC CHAIN REACTIONS. Quarterly Report, November 1961–January 1962. (Little (Arthur D.) Inc., Cambridge, Mass.). Feb. 28, 1962. Contract AT(30-1)-2904. 12p.

The radioinduced reactions of propylene and isobutane while adsorbed on silica gel-metal oxide surfaces was extended to include silica gel treated with copper (II) oxide and nickel (II) oxide. The variation in product yield with metal oxide was noted. The activity of the SiO_2-NiO gel was particularly striking. (auth)

13086 (TID-15262) ENERGETIC RECOIL ATOM REACTION MECHANISMS. Progress Report No. 2, February 28, 1961 to February 15, 1962. Adon A. Gordus (Michigan. Univ., Ann Arbor. Michigan Memorial-Phoenix Project). Feb. 1962. Contract AT(11-1)-912. 42p. (MMPP-167-3; MMPP-178-1; ORA-3710-2-P).

Activities are reported in investigations concerning momentum transfer to atoms in a molecule, failure to bond-rupture following recoil beta decay, mathematical models for hot-atom and hot-ion reactions and the effects of additives, and specific solutions for five-step three-dimensional random walks. (J.R.D.)

13087 (SCL-T-410) RADIATION CHEMISTRY OF THE HYDROCARBONS. PART IV. TOLUENE. Juerg Hoigné and Tino Gaeumann. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Helv. Chim. Acta, 44: 2141-50(1961). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 10056.

13088 USE OF FILTER PAPER MOUNTING FOR DETERMINATION OF THE SPECIFIC ACTIVITY OF GLUCONATE-C^{14} BY LIQUID SCINTILLATION ASSAY. Alberta Blair and Stanton Segal (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Anal. Biochem., 3: 221-9(Mar. 1962). (In English)

A simple technique is described for the assay of radioactivity in C^{14}-labeled gluconate by the liquid scintillation method. The method provides a reliable means of determining the C^{14} activity of milligram quantities of a substance not readily soluble in the liquid phosphors in use for scintillation counting. (auth)

13089 SUSPENSION SCINTILLATION COUNTING OF CARBON-14 BARIUM CARBONATE. H. J. Cluley (General Electric Co., Ltd., Wembley, Eng.). Analyst, 87: 170-7 (Mar. 1962).

A study was made of the suspension scintillation counting of carbon-14 barium carbonate with a very finely divided silica as the suspending agent. A 4% wt/vol concentration of the silica in the scintillator solution (0.3% wt/vol of 2,5-diphenyloxazole in toluene) gives an almost transparent gel capable of suspending up to 1 g of barium carbonate in 10 ml of solution. Counting efficiency was found to decrease somewhat with increasing concentration of barium carbonate; 0.1 and 0.5 g of barium carbonate gave counting efficiencies of 60 and 49%, respectively, compared with 71% for solution scintillation counting of carbon-14 under the same instrumental conditions. The high efficiencies with which substantial amounts of barium carbonate can be counted by the suspension technique represent a considerable gain over the efficiency of about 1% obtained by Geiger counting of barium carbonate under infinite thickness conditions. (auth)

13090 THE RADIATION CHEMISTRY OF OXYANIONS OF TRANSITION ELEMENTS. PART I. REDUCTION OF POTASSIUM PERMANGANATE IN AQUEOUS SOLUTIONS BY γ^{60}Co RAYS. B. Jezowska-Trzebiatowska and J. Kaleciński (Univ. of Wrocław, Poland and Inst. of Physical Chemistry, Polish Academy of Sciences, Wrocław, Poland). Bull. acad. polon. sci., Sér. sci., Chim., 9: 791-7(1961). (In English)

The kinetics and mechanism of the reduction of aqueous solutions of potassium permanganate by gamma radiation was investigated, as well as the ultimate establishment of the part played by OH radicals. It was found that the reduction may be divided into two periods: in the first, the increase of extinction D_{410} corresponds mainly to reduction of Mn(VII) to Mn(IV); in the second, during the linear decrease of extinction (decolorizing of solution), the reduction of Mn(IV) to Mn(II) occurs. The $G(-MnO_4^-)$ yield decreases with irradiation time. It was assumed that MnO_4 was subjected to hydration. (P.C.H.)

13091 MASS-SPECTROMETRIC STUDY ON IONIZATION AND DISSOCIATION OF DIETHYL ETHER BY ELECTRON IMPACT. Ichiro Kanomata (Tokyo Metropolitan Univ.). Bull. Chem. Soc. Japan, 34: 1596-9(Nov. 1961). (In English)

A mass spectrometric study on ionization and dissociation of diethyl ether was carried out. The M/e = 31 ion is the most abundant among the ions produced by 75 ev electron impact and the M/e = 29, 59, 45, and 74 ions are abundant in this order following the M/e = 31 ion. The appearance potential measurement of these ions leads to the conclusion that the ions are formed by the removal of one of the lone pair electrons of the oxygen atom in the molecule. By considering the trivalent structure of O^+ and by applying the bond energy additivity, which is adequate for hydrocarbons, to such an ionized dissociation process the producing processes of such ions can be satis-

factorily revealed. The stabilization energy for the formation of $>C=O^+$ structure is obtained as 54 kcal/mole by such a calculation. (auth)

13092 OXIDATION OF FERROUS IONS IN AQUEOUS SOLUTIONS BY COBALT-60 GAMMA RAYS. II. EFFECT OF ANIONS AT HIGH DOSE. Hiroshi Hotta and Shin-ichi Ohno (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 1640-4(Nov. 1961). (In English)

The $G(Fe^{3+})$ of air-free acidic ferrous sulfate solutions decreased gradually with the increase of dose due to the re-reduction of ferric ion produced. The decrement depended on the property of the anion as well as sulfuric acid in the solution in the order of $Cl^- > Br^- > SO_4^{2-} > F^-$. The relative reduction rate of ferric complexes was obtained as a result of the estimation of respective complexes in the solution; that is, ferric chloride and bromide complexes promote the reduction of ferric ion, and ferric sulfate and fluoride complexes suppress it. (auth)

13093 SYNTHESIS OF SEVERAL TERTIARY ALCOHOLS FROM PROPANOL-2 AND ETHYLENE BY GAMMA-RAY IRRADIATION. Kozo Hirota and Motoyoshi Hatada (Osaka Labs. and Osaka Univ.). Bull. Chem. Soc. Japan, 34: 1644-8(Nov. 1961). (In English)

Tertiary amyl and higher tertiary alcohols were synthetized at 6 to 60°C by irradiating gamma-rays on a mixture of propanol-2 and ethylene in glass vessels. It was found that as the irradiation temperature the G value of these telomers increases markedly, e.g. up to ca. 300 at 60°C. It was concluded from the distribution of the telomers produced that this reaction proceeds by a chain mechanism, with the isopropyl radical $(CH_3)_2COH$ as the chain-carrying radical. It was estimated that the characteristic effects of gamma rays will be found in the step prior to the production of the isopropyl radical. (auth)

13094 HOT-ATOM CHEMISTRY OF HEXAMMINECHROMIUM(III) NITRATE IN THE SOLID STATE. Nagao Ikeda, Kenji Yoshihara, Hiroshi Ebihara, and Kiyomi Suzuki (Tokyo Univ. of Education and Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 1705-10 (Nov. 1961). (In English)

A heterogeneous extraction method for enriching Cr^{51} recoil atoms in neutron-irradiated hexamminechromium(III) nitrate was investigated. The mechanisms of the reaction are discussed. The Cr^{51} atoms were extracted and enriched in the aqueous phase by shaking the target powder with concentrated HNO_3. Chemical forms of the recoil atoms were also studied. (M.C.G.)

13095 REACTOR FOR TESTING THE RADIATION-CHEMICAL EFFECT OF ELECTRIC DISCHARGES IN HIGH TEMPERATURES. G. Foeldiák. Chem. Tech. (Leipzig), 13: 748-9(Dec. 1961). (In German)

An experimental procedure for carrying out chemical reactions by high-voltage discharges was developed so that high temperature and pressure could be used. The instrument was designed to investigate, with or without the use of catalysts, reactions under the influence of an electric field, especially the radiochemical transformation of hydrocarbons. Oxidation and decomposition reactions can be studied. (M.C.G.)

13096 RADIOCHEMICAL BREAKDOWN PRODUCTS OF ^{131}I-LABELLED 3,5,3'-TRIIODO-l-THYRONINE. A. Van Zyl (Univ. of Cape Town). Clin. Chim. Acta, 7: 20-8(Jan. 1962). (In English)

Self-radiation products of I^{131}-labeled 3,5,3'-triiodo-l-thyronine were studied quantitatively. The four major radiochemical breakdown products formed are I^{131}, I^{131}-labeled 3,5-diiodothyronine, I^{131}-labeled thyroxine, and an hydroxyl acid analogue of triiodothyronine or of diiodothyronine or of both. The possible mechanism of self-radiation decomposition is discussed. (auth)

13097 THE RADIOLYSIS OF SOME POLYCYCLIC AROMATIC HYDROCARBONS. Ève de Gorski and Gabriel de Gaudemaris (Centre d'Études Nucléaires, Grenoble, France). Compt. rend., 253: 2965-6(Dec. 18, 1961). (In French)

Radiolysis, by accelerated electrons, was studied experimentally on a series of aromatic hydrocarbons with condensed nuclei and on some heterocyclic compounds. The stability depends largely on the structure of the hydrocarbon and increases in the first approximation with the number of condensed nuclei. (tr-auth)

13098 THE STRUCTURE OF THE RADIOCHEMICAL POLYMER OF CYCLOHEXENE. Georges Aude and Gabriel de Gaudemaris (Centre d'Etudes Nucléaires, Grenoble, France). Compt. rend., 254: 113-15(Jan. 3, 1962). (In French)

Under the effect of electrons, cyclohexene is polymerized. The dimer was isolated, and its exact structure was determined with the synthesis of several isomers. (tr-auth)

13099 DEPENDENCE OF EPR SPECTRA OF FREE RADICAL SPECIES IN POLYMETHYLMETHACRYLATE ON γ-IRRADIATION DOSE. R. Lenk (Nuclear Research Inst., Czechoslovak Academy of Sciences, Rez). Czechoslov. J. Phys., B 11: 876-7(1961). (In English)

Gamma dose effects on the electron paramagnetic resonance (EPR) structure of free radical species in polymethylmethacrylate (PMMA) were investigated. Cubic samples of 30 mm^3 volume were irradiated with Co^{60} at 1.17 r/hr. The EPR spectra were measured using an apparatus having 100-kc modulation and a 9300-Mc microwave system. Derivative curves of the spectra were obtained using a phase detector. Spectral-change data are presented in graphical form. (L.N.N.)

13100 SEPARATION OF Cs^{137} AND Sr^{90} FROM OLD FISSION PRODUCTS BY PAPER ELECTROPHORESIS. III. TEMPERATURE EFFECTS. P. Gerontopulos and E. Lazzarini (CESNEF, Milan and Istituto di Fisica del Politecnico, Milan). Energia nucleare (Milan), 9: 104-6 (Feb. 1962). (In English)

Migration lengths of Cs^+ and Sr^{2+} are linearly dependent on migration time and on electric field intensity at 10.9 to 54.5 v/cm. Measurements at different electric field intensities and migration times were conducted at 5 and 40°C. Zone mobilities were measured at 5 ± 1, 26 ± 1, and 40 ± 1°C. Data are presented in graphical and tabular forms. (L.N.N.)

13101 DETERMINATION OF α ACTIVITY IN SOLID RESIDUES IN WATER AND SOIL. V. F. Zheverzheeva (Inst. for General and Public Health, Academy of Medical Sciences, USSR). Gigiena i Sanit., No. 7, 69-74(July 1961). (In Russian)

Alpha emission from solid precipitates in water and soil was measured. Saturated layers were found to retain the particles emitted from lower layers. Data are tabulated for various specimens using pure U_3O_8 preparations as controls. (R.V.J.)

13102 NEW REAGENT FOR LABELING ORGANIC COMPOUNDS WITH TRITIUM. Paul M. Yavorsky and Everett Gorin (Consolidation Coal Co., Library, Penna.). J. Am. Chem. Soc., 84: 1071-2(Mar. 20, 1962).

An evaluation was made of the powerful acid complex $TH_3PO_4 \cdot BF_3$ for promoting hydrogen isotope exchange

labeling. The complex is easily made by stoichiometric admixture of tritiated water and P_2O_5 and saturation with BF_3 gas. Advantages of this labeling method are: radiochemically pure tracers often are produced immediately, obviating drastic post-labeling purification that may be required for some acids. Labeling is very rapid, sometimes requiring only a few hours to complete. It is simple, requiring no special equipment as for gas handling or high temperatures, and very high specific activity tracers can be produced where desired by starting with highly tritiated water. Initial labeling results with 9 organic compounds are tabulated. (P.C.H.)

13103 SEPARATION OF RADIOACTIVE ATOMS IN A CARRIER-FREE STATE WITH THE AID OF AN ELECTROCHROMATOGRAPHIC METHOD. I. Mádi (Univ. of Debrecen, Hungary). J. Inorg. & Nuclear Chem., 22: 169-81(Dec. 1961). (In German)

By an electrochromatographic method was separated various kinds of radioactive atoms were separated in a carrier-free state. By a cathodically polarized platinum powder column, for instance, the radioactive kind of atom Y^{90} from its parent element, Sr^{90}, and La^{140} from Ba^{140}, respectively. By an anodically polarized platinum powder column Pm^{147} was separated from Ce^{144}, and the natural radioactive kind of atom Bi^{212} from its parent element, Pb^{212}, respectively. (auth)

13104 THE REACTIONS OF NITRIC OXIDE IN IRRADIATED CYCLOHEXANE. E. J. Burrell, Jr. (E. I. du Pont de Nemours & Co., Wilmington, Del.). J. Phys. Chem., 66: 401-4(Mar. 1962).

Specific rate constants were measured for the reaction of nitric oxide with nitrosocyclohexane monomer and for the dimerization of nitrosocyclohexane monomer. The implications of these reactions for nitric oxide scavenging reactions are discussed. (auth)

13105 THE EFFECTS OF REACTOR IRRADIATION UPON THE SUBSEQUENT THERMAL DECOMPOSITION OF LEAD STYPHNATE. Ted B. Flanagan (Picatinny Arsenal, Dover, N. J. and Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 66: 416-21(Mar. 1962).

The kinetics of the thermal decomposition of lead styphnate were examined after being subjected to a series of irradiations in the graphite reactor. It was observed that the decomposition rate is enhanced and the activation energy for at least part of the decomposition is significantly decreased by nuclear irradiation. It also was found that it did not make any difference in the subsequent thermal decomposition whether the material was irradiated as the anhydride or as the monohydrate. Possible mechanisms for the decomposition of the irradiated salt are discussed. (auth)

13106 OXYGEN DIFFUSION AND REACTION DURING γ-IRRADIATION OF POLYETHYLENE. R. C. Giberson (General Electric Co., Richland, Wash.). J. Phys. Chem., 66: 463-8(Mar. 1962). (HW-SA-2254)

A model for the diffusion-controlled reaction of oxygen with polyethylene in an irradiation environment is presented. Experimental and calculated results on carbonyl formation in thin films (0.0020 to 0.0400 cm) agree to $\pm 5\%$ for an exposure range of 5 to 100×10^6 r. The effect of dose rate, from 1 to 5×10^6 r/hr, on the rate of carbonyl formation is studied and evaluated in terms of the proposed model. (auth)

13107 THE NATURE OF THE REDUCING RADICAL IN WATER RADIOLYSIS. Gideon Czapski and Harold A. Schwarz (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 66: 471-4(Mar. 1962). (BNL-5667)

The kinetic salt effect is utilized to demonstrate that the reducing radical produced in water radiolysis has a unit negative charge and may be considered a solvated electron, designated H_2O^-. The effect of ionic strength on three rate constant ratios among the following four reactions was measured. $H_2O^- + H_2O_2 \rightarrow OH + OH^- + H_2O$, $H_2O^- + O_2 \rightarrow HO_2 + OH^-$, $H_2O^- + H_3O^+ \rightarrow H + 2H_2O$, and $H_2O^- + NO_2^- \rightarrow NO_2^- + H_2O$. The ratio k_2/k_1 is unaffected by ionic strength while k_3/k_1 decreases and k_4/k_1 increases with increasing ionic strength. From the slopes of the ionic strength curves the charge on the reducing radical is determined to be minus one. (auth)

13108 N^{13}-LABELLED PRODUCTS FROM C^{12}(d,n) REACTION IN ALCOHOLS. W. C. Perkins and W. S. Koski (Johns Hopkins Univ., Baltimore, Md.). J. Phys. Chem., 66: 474-7(Mar. 1962).

The N^{13}-labeled compounds produced when gaseous methane, methanol, or ethanol are bombarded with 2 Mev deuterons were investigated. HCN^{13} and CH_3CN^{13} are the gaseous activities found for CH_4 and CH_3OH. These activities plus $C_2H_5CN^{13}$ were found in ethanol bombardments. Experiments with rare gas additives and Br_2 suggest that cyanogen ion or radical is the B^{13} carrier and that the HCN is formed by reaction with materials on the wall of the vessel, whereas the CH_3CN is formed by reaction with target gas molecules in the gas phase. (auth)

13109 ACTIVATION OF METAL HYDROGENATION CATALYSTS BY IRRADIATION. Donald Graham (E. I. du Pont de Nemours & Co., Wilmington, Del.). J. Phys. Chem., 66: 510-11(Mar. 1962).

The catalytic activities of supported metal hydrogenation catalysts (nickel, palladium, and platinum) were increased by high energy irradiation. The improvement sometimes exceeded 20%. Active centers appeared to be both created and destroyed by irradiation, the latter effect possibly involving an annealing process. In general, the energy required for forming new active centers and also the stability of these centers vary directly with the temperature required for diffusion of the atoms in the surface of the catalyst metals, which temperature is a function of their melting points. (auth)

13110 PRODUCTION OF RADIOACTIVE ISOTOPES. J. J. Arlman (N.V. Philips-Dupbar, Amsterdam). Medicamundi, 7: 140-4(1961). (In English)

Artificial radioisotopes with a shortage of neutrons are converted into stable nuclei by positron emission or electron capture and are generally produced in a particle accelerator, while artificial radioisotopes with an excess of neutrons are converted by electron emission and are produced in a reactor. Examples are given of both types, and discussion is given on the nuclear reactions leading to their generation. A few of the conditions (low or high flux, irradiation time, irradiation energy) that must be complied with in order to obtain reasonable yields of certain artificial radioisotopes are mentioned. (auth)

13111 FREE RADICAL FORMATION AND OXYGEN EFFECT IN IRRADIATED POLYMETHYLMETHACRYLATE. Alan Carrington and Gabriel Stein [(Cambridge Univ., Eng.)]. Nature, 193: 976(Mar. 10, 1962).

The effects of oxygen treatment on the electron spin resonance spectrum of irradiated Perspex were studied. When Perspex was irradiated with large doses in the absence of oxygen, the 4 + 5 line spectrum due to the methylmethacrylate free radical appeared and underwent only minor modifications on subsequent exposure to air or oxygen for

periods up to 12 weeks. However, when Perspex saturated with oxygen by diffusion was irradiated with 45 krad x rays, a spectrum characteristic of peroxide radicals appeared, and no trace of the 4 + 5 line spectrum was observed except at higher doses. At doses on the order of 1 Mrad, the peroxide spectrum was swamped by the 4 + 5 line spectrum. (D.L.C.)

13112 EFFECT OF β- OR/AND γ-RAYS ON GAS DISCHARGE. M. Venugopalan (Banaras Hindu Univ., India). Nature, 193: 976-7(Mar. 10, 1962).

An ozonizer filled with Cl_2 gas at 120 mm Hg and under 50 cps excitation produced a new effect when irradiated with β and/or γ rays. The radiation of fixed activity increased the discharge current in darkness at low applied potentials, but at higher potentials the current change decreased and became negative. A similar inversion of the current change was observed when the activity of the radiation was increased to 6,650 cpm. (D.L.C.)

13113 GAMMA-IRRADIATION DAMAGE IN MONOSACCHARIDES. M. A. Collins (Dominion Physical Lab., Dept. of Scientific and Industrial Research, Lower Hutt, New Zealand). Nature, 193: 1061-2(Mar. 17, 1962).

The electron spin resonance spectra of irradiated monosaccharides were examined to determine the centers of damage causing the signal. The results suggest that damage to the monosaccharide ring structure can be transferred around the ring and stabilized at the chemically active points. For d-glucose, the side group $-CH_2OH$ and the linkage carbon accumulate the damage to display a $-CH_2\cdot$ or $\cdot\overset{|}{\underset{|}{C}}-CH_2OH$ radical (triplet) and a radical associated with the ring structure (singlet). For galacturonic acid, irradiation produces a single line which can be attributed to the ^-COOH side group. D-xylose requires a modification of its normal ring structure before the spectrum can be explained in terms of a triplet spectrum. (D.L.C.)

13114 RESEARCH OF RADIOISOTOPES PRODUCTION WITH FAST NEUTRONS. I. PREPARATION OF CARRIER-FREE ^{58}Co. Chizuko Shikata, Eiji Shikata, and Nagao Shibata (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 105-10(Feb. 1962). (In English)

Co^{58} was prepared by the reaction $Ni^{58}(n,p)$ in carrier-free Co^{58}. Cobalt-free nickel was prepared by anion exchange, and nickel was precipitated as carbonate. By the irradiation of 50 g of nickel carbonate for 60 hr, 230 μc of Co^{58} were prepared at maximum. Since Co^{58} was formed with fast neutrons, the fast neutron flux was measured by this reaction and was determined to be 2.1×10^{12} n/cm^2/sec. Yields of other carrier-free radioisotopes from nickel reactions with neutrons are also given. (auth)

13115 FISSION TRACK NUCLEATION OF HYDROGEN BUBBLES IN URANYL SULFATE SOLUTIONS. P. Spiegler (Atomics International, Canoga Park, Calif.), C. Bumpus, and A. Norman. Phys. Fluids, 5: 366-7(Mar. 1962).

The critical hydrogen concentration required for growth of a fission track nucleated bubble in aqueous $U^{235}O_2SO_4$ solutions exposed to intense neutron bursts (10^{13} to 10^{14} neutrons/cm^2 with half-widths of 4 to 20 msec) was computed from the G_{H_2} values and the measured energy release from the beginning of the neutron burst to the onset of the pressure. The bubbles cause a readily observed rapid rise in liquid pressure. The hydrogen is generated from the radiolysis of water in the process. Data show that the nucleation radius of the bubble is independent of temperature (20 to 80°C), liquid pressure (1 to 10 atm), surface tension (35 to 75 dynes/cm), dissolved gas concentration (1.0 to 2.5×10^{-3} g H_2/100 g of solution), and uranium concentration (170 to 400 g U/liter). The mechanism of bubble growth is expressed in terms of energy release, nuclei lifetime, and diffusion action. (N.W.R.)

13116 ISOTOPENCHEMIE. (Isotope Chemistry). A. I. Brodskii (Alexander E. Brodsky). Berlin, Akademie-Verlag, 1961. 712p. DM 86. Translated by J Muehlenpfordt from "Khimiya Izotopov." Moscow, Publishing House of the Academy of Science, 1957.

An introduction is presented to the area of applied isotope chemistry. Topics discussed include the following: chemical elements and their isotopes; isotopes in nature; the separation of stable isotopes; analyses of stable isotopes; radioactive isotopes; the physical-chemical characteristics of isotopes; isotope exchange reactions; mechanisms of chemical reactions; applications of isotopes in chemical analysis, technology, and agriculture; and uses of isotopes in biology. (M.C.G.)

13117 IMPROVEMENTS RELATING TO ARTIFICIAL SHAPED STRUCTURES. (to E. I. Du Pont de Nemours & Co.). British Patent 891,944. Mar. 21, 1962.

A process is given for producing structures composed of spongy and reticulated polymeric fibers. The process comprises the steps of subjecting a plexifilament formed from a linear polyethylene or polypropylene to ionizing radiation while in intimate contact with an unsaturated organic acid, e.g., acrylic or methacrylic acid. After the irradiation and grafting, the acid groups may be converted into salt groups and the resulting plexifilaments used to make fabrics and paper. (D.L.C.)

Raw Materials and Feed Materials

Refer also to abstract 12837.

13118 (PAN-272/IV) COMPORTEMENT DES COMPOSÉS DE FER PENDANT L'EXTRACTION GAZEUSE DE L'URANIUM DE SES MATIÈRES PREMIÈRES. (Behavior of Iron Compounds During Gaseous Extraction of Uranium from its Raw Materials). Jaroslaw Zienkiewicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Sept. 1961. 8p.

In high-temperature uranium ore chlorination the yield of volatile iron is about 80% of the initial iron. At lower temperature the yield is diminished. The amount of chlorine, the flow velocity, the concentration, and content of carbon are of lesser importance in the process. (tr-auth)

13119 INTERACTION OF THE FATTY-ACID COLLECTOR WITH URANINITE DURING THE FLOTATION PROCESS. L. A. Grekulova. Atomnaya Energ., 12: 140-6(Feb. 1962). (In Russian)

Studies were made on the useability of flotation processes for treating uraninite ores the surface properties of which are insufficiently known. The investigation included a study of the sorption of Na oleate on the surface of the ore in an aqueous medium, determination of the electric properties of the surface and of the ζ potential, and determination of the solubility of uranyl oleate and of other cations in water. It was found that the natural surface of the ore collects up to 1 Na oleate monolayer, holding it more weakly than quartz. Although 80% can be washed off, the remaining 20% is sufficient for the flotation of most minerals. The surface of uraninite was found to be negatively charged in distilled water; the observed overvoltage is due to the sorption of potential-forming H^+ and

OH^- ions within the double layer. The interaction of uraninite with the fatty acid collector probably involves a chemisorption process. A very small amount of oleate (8 to 10 g per ton) is sufficient to flotate the ore from a single-material system, but in the case of a mixture 1.0 to 1.2 kg were needed. (TTT)

13120 THE EXTRACTION OF URANIUM FROM THE UM-BAREK OIL SHALE. M. Liquornik (Israel Atomic Energy Commission Labs., Rehovoth). Bull. Research Council Israel, Sect. C, 10: 171-6(Jan. 1962). (In English)

The Um-Barek shale contains approximately 13 g/ton uranium and as such is a potential source for this metal. An attempt was made to extract the uranium with acid and alkaline leach, as well as with neutral reagents. However, no way to extract uranium economically was found. (auth)

13121 INFLUENCE OF GAS FLOW ON DTA CURVES OF UO_2. D. Kolar, E. D. Lynch, and J. H. Handwerk (Argonne National Lab., Ill.). J. Am. Ceram. Soc., 45: 141-2(Mar. 1962). (ANL-FGF-304)

Differential thermal analysis (DTA) curves for uranium dioxide vary considerably when oxygen flows through the sample bed at a flow rate of about 25 cm^3/min as compared to static conditions. The observed differences can be explained on the basis of suggested mechanisms for the oxidation of uranium dioxide. The shape of the first peak ($UO_2 \rightarrow U_3O_7$) corresponding to a diffusion-controlled reaction is not appreciably affected by flowing oxygen. The second peak, reported to indicate the breakup of the particles with subsequent oxidation on the U_3O_8, is strongly affected by oxygen flow. It is obvious that oxygen availability plays an important role for the $U_3O_7 \rightarrow U_3O_8$ oxidation step. The influence of particle size on DTA curves is also shown. The DTA curve for the coarser sieve fraction which possesses low surface area had only one strong exothermic peak at about 440°C. Both peaks were observed with the higher-surface-area fractions. Thus, flowing oxygen and particle size influence the intensity of the peaks, the temperature at which the reaction takes place, and even the existence of the DTA peaks. (N.W.R.)

13122 PREPARATION OF HIGH PURITY UF_4. James E. Magner, Ray S. Long, David A. Ellis, and Robert R. Grinstead (to U. S. Atomic Energy Commission). U. S. Patent 3,030,175. Apr. 17, 1962.

A process for preparing very highly pure uranous tetrafluoride from impure uranium laden solvent extraction strip solutions, ion exchange process and resin-in-pulp process eluate solutions which are at least 8M in hydrochloric acid is described. The process first comprises treating any of the above-mentioned solutions with a reducing agent to reduce the uranium to the +4 oxidation state, and then contacting the reduced solution with an extractant phase comprising about 10 to 70% of tri-butyl phosphate in an organic solvent-diluent selected from benzene, ethyl-benzene, chlorobenzene, xylene, kerosene, or the like. The uranium is extracted into the extractant phase and is subsequently precipitated by treating the extractant with an aqueous fluoride solution. The highly pure uranous tetrafluoride precipitate is separated from the phases and recovered for subsequent utilization. (AEC)

Separation Processes

Refer also to abstract 12838.

13123 (BLG-67) PREPARATION DU PHOSPHORE-32 SANS ENTRAINEUR ISOTOPIQUE PAR EXTRACTION LIQUIDE-LIQUIDE. (Preparation of Carrier-Free Phosphorus-32 by Liquid-Liquid Extraction). R. Constant (Brussels. Centre d'Etude de l'Energie Nucleaire). Oct. 1961. 14p.

Presented at the International Congress of the Chemical Industry, Bordeaux, 1961.

P^{32} is normally produced by the "threshold reaction" $S^{32}(n,p)P^{32}$. A liquid-liquid solvent extraction process using toluene and dilute HCl is described, by which slightly acid aqueous solutions of high-specific-activity P^{32} can be separated with radiochemical purities higher than 99%. The use of benzene or tetrachloroethane is also studied. The yield using toluene is more than 80% for one extraction, and more than 95% for two consecutive extractions. (tr-auth)

13124 (DP-349) CONCENTRATION OF PLUTONIUM BY CATION EXCHANGE—STABILIZATION OF Pu(III) IN NITRIC ACID. Frank W. Tober and Edwin R. Russel (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). Feb. 1959. Contract AT(07-2)-1. 20p.

A study to define the effectiveness limits of sulfamic acid and to discover other better stabilizers for Pu(III) is described. Ascorbic and isoascorbic acids, used in conjunction with sulfamic acid reduced Pu(IV) to stable Pu(III) in nitric acid. Aminoguanidine sulfate also retarded the oxidation of Pu(III) but did not reduce Pu(IV). (J.R.D.)

13125 (HW-70536) ABSORPTION OF THORIUM ON AN ANION EXCHANGE RESIN. J. L. Carroll (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 8, 1961. Contract AT(45-1)-1350. 33p.

The effects of nitric acid concentration, thorium concentration, and temperature on the sorption of thorium by Permutit SK anion exchange resin were studied. Equilibrium resin loadings were found to decrease markedly with decreasing nitric acid or thorium concentration in the contact equilibrated solution. Increased temperature also decreased resin loadings although the decrease was less striking. A distribution coefficient of 76.7 was observed for a contact solution containing 7 M HNO_3 and 2 g Th/liter at 25°C. Decreasing nitric acid concentration to 4 M in an otherwise identical solution decreased the distribution coefficient to 5.34. Diffusivity of thorium within the resin was found to increase from 78.4×10^{-9} cm^2/sec in 8 M HNO_3 to 5.1×10^{-7} cm^2/sec in 0.5 M HNO_3. In agreement with proposed theories the diffusion rate was independent of thorium concentration in the contact solution. The activation energy for absorption, calculated from diffusion rate measurements, was 2.64 Kcal/g mole. (auth)

13126 (IDO-14573) ELECTROLYTIC DISSOLUTION OF NUCLEAR FUELS. PART I. ZIRCONIUM IN HCl–METHANOL. J. R. Aylward, E. M. Whitener, and H. T. Hahn (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 29, 1961. Contract AT(10-1)-205. 23p.

The electrolytic dissolution of zirconium in HCl–methanol was studied as a function of potential, solution composition, and temperature. The dissolution is characterized by two regions. At high potentials the zirconium is electropolished and complete dissolution is achieved. At low potentials the current is an exponential function of the potential (Tafel behavior). In this region a small amount of finely divided α-zirconium which is insoluble in HCl–methanol separates from the bulk metal. The energy of activation for the corrosion reaction (0.0 volt) is 16.5 kcal/mole; in the electropolishing region (1.0 volt) the activation energy is 7.7 kcal/mole. A broad solvent

capability for metallic reactor fuels is offered by the HCl–methanol medium since, in addition to zirconium, stainless steel is also dissolved electrolytically while uranium and aluminum dissolve chemically. Other process implications are discussed. (auth)

13127 (NAA-SR-6976) OXIDATION-REDUCTION REPROCESSSING OF URANIUM CARBIDE REACTOR FUEL. I. CARBOTHERMIC REDUCTION OF UO_2. W. G. Smiley (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 15, 1962. Contract AT(11-1)-Gen-8. 25p.

Gram-scale experiments on the carbothermic reduction of UO_2 were carried out as part of an investigation of oxidation-reduction reprocessing of UC. UO_2, from air oxidation of UC, was mixed with graphite powder and heated in vacuum at 1300 to 1700°C, both as loose powder and as pellets. The best container material was carbide-coated graphite; molybdenum was satisfactory with pellets. Information on reaction rates was obtained by measuring the evolved carbon monoxide with a gas meter. In the powder experiments, the carbon content of the products agreed with predicted values, with a standard deviation of 0.069 wt %. The carbon content of products from pellets was low by 0.25 wt %, with a standard deviation of 0.076 wt %. This is believed to be an effect of the acrylic plastic binder. Reaction rates followed a second-order rate equation, except that the rate constant often decreased abruptly at about 90% completion. Correlation between rate and temperature was poor; for 32 values of the rate constant, K (reciprocal hours), the least squares equation was: $\log K = 9.82 - 16{,}080/T$, with a standard error of 0.20 in log K. The data also agree fairly well (standard error, 0.22) with the hypothesis that the activation energy is equal to the heat of the endothermic reaction. Because of variations in the rate, it is recommended that the reaction of each batch should be followed with a gas meter, in order to obtain a desired degree of completion. (auth)

13128 (NYO-10183) EXTRACTION OF INORGANIC SUBSTANCES BY ORGANIC SOLVENTS. Final Report. H. M. Clark (Rensselaer Polytechnic Inst., Troy, N. Y.). Mar. 19, 1962. Contract AT(30-1)-1663. 14p.

The experimental methods used and results and conclusions from a study of the extraction of inorganic substances by organic solvents are presented. Among the inorganic substances investigated in detail were ferric chloride, ruthenium chloride, tantalum fluoride, ferric bromide, aluminum chloride, and lithium tetrachloroferrate. The organic solvents used most frequently were diethyl ether, di-isopropyl ether, and tri-n-butyl phosphate. A list of reports, theses, and papers on extraction studies is given. (P.C.H.)

13129 (PAN-267/IV) KINETYKA PROCESU KATODOWEGO PRZY OSADZANIU TORU ZE STOPIONYCH SOLI. CZĘŚĆ I. BADANIA ThF_4 I ThF_4–CaF_2. (Kinetics of Cathode Processes in Separation of Thorium from Molten Salts. Part I. Investigation of ThF_4 and ThF_4–CaF_2). S. Mints and V. Rafal'skii (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Sept. 1961. 19p.

The current-intensity curves of non-electrolyzed salts and the curves of time-intensity and current-intensity in electrolyzed salts were plotted for molten ThF_4 and ThF_4–CaF_2. The intensity of salt disintegration was determined, and electric conductivity in electrolyte was observed. (tr-auth)

13130 (PAN-271/VIII) APPLICATION OF THE NORMAL DISTRIBUTION TO THE QUANTITATIVE ESTIMATION OF ELUTION CURVES. Jerzy Minczewski and Rajmund Dybczynski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Sept. 1961. 23p.

The possibility of quantitative determination of substances in mixture by means of column chromatography for the case of linear isotherm was considered. Taking as a starting point the plate theory and using the normal distribution, a formula was derived for the calculation of total content A, of a substance in the analyzed sample: $A = 0.886\ M_{max}w$; where M_{max} is the peak height and w its width at the ordinate value of $M = M_{max}/e$. The formula given above enables the quantitative determinations from elution curves which may be drawn automatically or on the base of analysis of only a few among a great number of fractions collected. Theoretical considerations were verified on the example of previously described method of rare earth separation on anion exchange resins. This method is based on taking an advantage from differences in distribution coefficients of lanthanide complexes with ethylenediaminetetraacetic acid. Applying radioactive tracers Ho^{166} and Tm^{170} the comparison was made between the results of determinations from elution curves and those obtained from direct activity measurements of standard solutions. By means of statistical methods, it was shown that both series of determinations give, in principle, identical results. The possibility of application of this method in activation analysis of rare earths and in some investigations in the field of nuclear physics is pointed out. (auth)

13131 (PAN-280/IV) KINETYKA PROCESU KATODOWEGO PRZY OSADZANIU TORU ZE STOPIONYCH SOLI. CZĘŚĆ II. BADANIA $ZnFe_2$. (Kinetics of Cathode Process in Separation of Thorium from Molten Salts. Part II. Investigation of ZnF_2). V. Rafal'ski and S. Mints (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Nov. 1961. 10p.

The intensity of ZnF_2 disintegration in molten CaF_2 and ThF_4 salts was determined at 1100°C. (tr-auth)

13132 LABORATORY NUCLEAR FUEL PROCESSING PLANT. C. Hanson and D. A. Kaye (Bradford Inst. of Tech., [Eng.]). Chem. & Process Eng., 43: 113-16 (Mar. 1962).

A uranium solvent extraction unit based on the mixer-settler principle is described. The laboratory unit is especially designed for teaching chemical engineering students the techniques of uranium fuel preparation and reprocessing. Information is presented on the operation of the equipment, equipment layout, safety precautions, flow system, and plant performance. (N.W.R.)

13133 EFFICIENCY OF LIQUID EXTRACTION PROCESSES. G. V. Jeffreys (Univ. of Birmingham, Eng.). Chem. & Process Eng., 43: 117-19 (Mar. 1962).

Basic studies carried out on the mechanism of mass transfer between two liquid phases, particularly recent models that postulate continual renewal of interface, are reviewed. The efficiency of extraction equipment and the significance of drop coalescence are discussed. It is stated that the overall stage efficiency of liquid extraction processes can be increased by better control of the solubility of the extractable solute, accomplished by addition of prosolvents and anti-solvents. (N.W.R.)

13134 PLANT MATERIAL BALANCE. CONSTRUCTION AND INTERPRETATION. Fred H. Tingey. Ind. Eng. Chem., 54: No. 4, 36-41 (Apr. 1962).

Discussion is given on risks involved in shutting down a chemical process. A procedure by which an optimum decision can be made on the basis of the data at hand is presented. It is felt that the technique is most appropriate to processes characterized by high unit dollar value and/or

significant strategic value. Also, processes in which a potentially hazardous situation might result from an undetected accumulation of an appreciable quantity of material, even though the dollar value may be small, would be especially amenable to the technique. (P.C.H.)

13135 NITRIC ACID DISSOLUTION OF URANIUM–MOLYBDENUM ALLOY REACTOR FUELS. Wallace W. Schulz, Raymond E. Burns, and Edward M. Duke (General Electric Co., Richland, Wash.). Ind. Eng. Chem., Process Design Develop., 1: 156-60(Apr. 1962).

Nitric acid dissolution procedures for the preparation of redox process solvent extraction feedstocks from U–Mo alloy reactor fuels were developed. Special dissolution procedures are required to prepare low-acid solutions of relatively high (0.75M or greater) uranium content because of the limited solubility of uranyl polymolybdate and MoO_3. In one procedure U–Mo alloys are dissolved in 3 to 5M HNO_3–0.5 to 1.0M $Fe(NO_3)_3$ solutions; under proper conditions dissolution can be accomplished without precipitation of solids. An alternative technique involves dissolution in concentrated (≥12M) HNO_3. This process requires separation of large amounts of MoO_3, neutralization or destruction of residual HNO_3, and extensive treatment of MoO_3 to remove occluded uranium and plutonium. The necessity for a difficult liquid-solid separation step is avoided by dissolution in HNO_3–$Fe(NO_3)_3$ solutions. (auth)

13136 SOLVENT EXTRACTION OF INORGANIC IONS WITH TRI-N-OCTYL PHOSPHINE OXIDE. Tomitaro Ishimori, Kan Kimura, Takeo Fujino, and Hiroko Murakami (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 117-26(Feb. 1962). (In English)

The extraction behavior of about sixty inorganic ions was studied in the respective systems of tri-n-octyl phosphine oxide (TOPO)-HCl and -HNO_3 for a contribution to the radiochemical separation techniques. TOPO was dissolved in toluene and used as its 5% (wt/vol) solutions, and the distribution ratios for each elements were determined. Acid dependence curves were obtained for the elements ranging from sodium to uranium, and arranged in the order of the periodic table. In general, the K_d values in HCl system are not only higher than those in HNO_3 but many curves show maximal K_d values in the acidity range from 2 to 10 M HCl while many curves show minimal values in the HNO_3 system. The K_d values or the shapes of curves were found to give strong resemblance to corresponding acid system among tri-n-butyl phosphine oxide (TBPO)-HCl and tri-n-butyl phosphate (TBP)-HCl or -HNO_3 systems. However, different behavior in TBP was observed in the extraction of yttrium, lanthanum, and lanthanide elements in HNO_3 system; they have high K_d values at 1 M acidity. Uranium also showed clearly different results to TBP extraction at 1 M HNO_3. It was also found that the extractability with TOPO is higher than that with TBP. (auth)

13137 REMOVAL OF THE MORE NOBLE NONVOLATILE FISSION PRODUCTS FROM URANIUM–BISMUTH FUELS. Orrington E. Dwyer (Brookhaven National Lab., Upton, N. Y.), Herbert E. Howe, and Edward R. Avrutik. Nuclear Sci. and Eng., 12: 15-22 (Jan. 1962). (BNL-3927)

The liquid-metal-fuel reactor concept in its commonest version is a thermal breeder and employs as a fuel a dilute solution of U in molten Bi. About 28% of the nonvolatile fission products are less reactive chemically than U. This FPN group is further divided into three subgroups according to the proposed methods of removal. The FPN-I's would be removed by oxidizing them to chlorides with fused salts, the FPN-II's by precipitating them directly from the liquid fuel, and the FPN-III's by reaction with Zn to form low-density intermetallic compounds which are insoluble in Bi. The FPN-II's, representing about 90% of the FPN's, would be removed continuously, while the others, because of their low yields or relatively low thermal cross sections, would be allowed to build up in the fuel for several years without causing any particular concern. The FPN-I's would be removed by the same continuous process proposed for removing those nonvolatile fission products which are more reactive than U, while the FPN-III's would be removed in a batch process similar to that used in the refining of Bi. Information is included on the rates of build-up of FPN elements in the fuel, steady-state concentrations of the FPN-II elements, reactor poisoning level of the FPN's, and experimental results in support of the proposed methods of removal. (auth)

13138 ELECTROLYTIC DISSOLUTION OF REACTOR FUELS. C. M. Slansky, M. W. Roberts, and K. L. Rohde (Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Sci. and Eng., 12: 33-8(Jan. 1962).

Electrolytic dissolution in a nitric acid electrolyte is promising as a universal headend in the recovery of uranium from a wide variety of nuclear fuels. A number of fuel materials of different shapes are dissolved continuously without difficulty. Preliminary studies indicate the applicability of electrolytic dissolution in the decladding of UO_2 and the cutting of stainless steel fuel cans. (auth)

13139 SOLVENT EXTRACTION EXPERIMENTS IN NUCLEAR FUELS PROCESSING. R. F. Makens and Dale E. Bush (Michigan Coll. of Mining and Tech., Houghton). Nuclear Sci. and Eng., 12: 71-8(Jan. 1962).

A convenient and relatively inexpensive unit for continuous countercurrent solvent extraction is described and suggestions are made for the use of the unit as a teaching tool in the training of nuclear engineering students in the diffusional processes associated with nuclear fuels processing. The need for such training is emphasized particularly for the heterogeneous groups entering the nuclear engineering field. (auth)

13140 REMOTELY OPERATED DISPERSION-COALESCENCE TESTER. C. M. Slansky. O. W. Parrett, and K. L. Rohde (Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Sci. and Eng., 12: 111-14(Jan. 1962).

A remotely operated device was developed for determining the coalescence times of solvent extraction plant process streams suspected of containing surfactants. Using the device, the coalescence times of pilot plant extraction column feed streams were correlated with observations of column behavior. Measurements made on plant streams derived from fully-irradiated fuels were used in the Idaho Chemical Processing Plant to predict the behavior of such streams and to prevent attempted processing with incompatible chemical systems. (auth)

13141 MECHANISM STUDY OF EXTRACTION OF CERIUM FROM MOLTEN URANIUM WITH URANIUM DIOXIDE. Tennyson Smith (Atomics International, Canoga Park, Calif.). Trans. Met. Soc. AIME, 224: 206-14(Apr. 1962).

The removal of cerium from molten uranium by extraction with uranium dioxide was investigated. Chemical analysis, metallography, and x-ray diffraction were used to study the kinetics of the extraction process. It was concluded that the extraction is controlled by different mechanisms during three consecutive time periods, as follows: chemical reaction at the molten uranium–uranium dioxide interface, diffusion of cerium in molten uranium, and dif-

fusion of oxygen through a solid reaction product layer. (auth)

13142 DOTYCZĄCE ZAGADNIEŃ EKSTRAKCJI W TECHNICE JĄDROWEJ. JUGOSŁOWIAŃSKO–POLSKIE, KOLOKWIUM, KOWARY, 7-13 WRZESIEŃ 1961. (Extractions in Nuclear Technology. Yugoslav–Polish Colloquium, Kowary, [Poland], September 7-13, 1961). (Institut za Technologiju Mineralnih Sirozina, Belgrade; Institut "Rudjer Bošković," Zagreb; Nuklearni Institut "Jošef Stefan," Ljubljana, Yugoslavia; Institut za Nuklearne Nauke "Boris Kidrič," Belgrade; and Polish Academy of Sciences, Inst. of Nuclear Research, Warsaw). 305p. (Polish Atomic Energy Commission).

The topics presented cover mostly the extraction of uranium and thorium. By title, they are as follows: one component system for extraction; influence of dilution on the extraction of europium and thorium nitrate with tributylphosphoran; mechanism of extraction with hyperchlorate of tributylphosphoran; extraction of uranium salts and mineral acids with alkali sulfates; metallic acetylacetonates–structure and applications to extraction; continuous cyclic extraction; extraction of inorganic compounds; extraction of niobium and zirconium with tri-iso-octylammonium; absorption of uranium with solutions of highly basic carbonates; extraction of uranyl carbonate with solutions of Na_2CO_3 and $NaHCO_3$; technological properties of highly basic anionic compounds used in Poland; absorption of uranium from dilute solutions; extraction of uranium-VI and thorium; further experiments with extraction of uranium and iron with alkylophosphoric acids; extraction of germanium with dioctyl ester of methyl diphosphoric acid and its separation from arsenic; synergistic effects in the extraction of plutonium compounds; dialkylomethyl biphosphoric acid as a means of extracting U, Th, and V; extraction of uranium and titanium organic metallic complexes; mono-octyl ester of alpha-amylbenzylphosphoric acid for metallic separations; preliminary experiments in the separation of uranium and plutonium, and fission product extraction; application of separation chromatography to radioisotope separation; automatic and continuous separation of radio-nuclides with counter-current extraction; uranium extraction in quarter-technical ores with the aid of tri-n-octylamine; extraction of Fe-III with tributyl-phosphate from solutions of beryllium sulfate; extraction of uranium with tri-n-butylphosphate from semi-technical ores. (TTT)

13143 THE EFFECT OF INDIVIDUAL COMPONENTS OF AN EXTRACTION SYSTEM ON THE EXTRACTION EFFICIENCY. F. Krašovec (Nuklearni Institut "Jošef Stefan," Ljubljana, Yugoslavia). p.1-13 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko–Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

Solvent extraction systems for the separation and extraction of the actinide and lanthanide elements are considered. The importance of the chelating reagents, organic solvents, and metallic ions are examined separately. Tables in which the values of the dissociation constant, separation constant, dimerization constant, and equilibrium constant are given for the following reagents: HDBP, HDOP, HDPP, HDTP, HD-pCl-PP, and HDNP. It is shown, further, that the separation and dimerization constants of HDBP increase with increasing dipole moment of the organic solvent. The systematics of the efficiency of solvent extraction are described in terms of parameters involving the equilibrium constant, the ionic charge and ionic radius. A selectivity parameter, P, is derived, and shown to be essentially constant for various systems. It is concluded that it is unlikely that new reagents or solvents will be found, which will have an appreciable influence on the value of P, or which will exhibit improved separation characteristics. (TTT)

13144 EXTRACTION OF URANIUM SALTS AND MINERAL ACIDS WITH THE AID OF ALKALI SULFATES. W. Korpak (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). p.18-36 of "Dotyczące Zagadnień Ekstrakcji w Technice Jadrowej. Jugosłowiańsko–Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Polish)

After a review of solvents used in the extraction of acids and inorganic salts, of the advantages of each as well as associated difficulties, the phenomena of synergistics and antagonism are discussed. The physical and chemical properties of alkali sulfates are presented, followed by a listing of the experimental and analytical methods used in the investigations that are the subject of this paper. The investigations include: (1) the extraction of mineral acids with the aid of sulfoxides (i.e. ethyl-dodecyl), (2) the extraction of acid salts and (3) of uranyl chloride. The investigations show that the effects of sulfoxides on the system $UO_2SO_4–H_2SO_4$–DDPA induces an antagonistic reduction of E, the coefficient of extraction of uranium. Also, the effect increases with increasing length of the sulfoxide chain. In the system $UO_2SO_4–H_2SO_4$–D2EHPA, the addition of $DHSO_4$ induces a synergistic increase of E. This effect is about three times larger than when $DHSO_4$ is introduced into the system that includes TBP. (TTT)

13145 METALLIC ACETYL ACETONES–STRUCTURE AND APPLICATION IN EXTRACTIONS. C. Djordjević (Institut "Rudjer Bošković," Zagreb). p.37-55 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko–Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

This review paper gives first some of the properties of acetylacetones which make them useful in solvent extraction processes. Acetylacetone forms well-defined chelates with practically all elements. Many of these complexes are much more soluble in organic solvents than are the chelates commonly used in analytical chemistry. This makes acetylacetones very useful for the quantitative extraction of trace elements, such as radioactive Fe^{59} from neutron-irradiated cobalt. Extractions can be performed in more acid media, since the reagent concentration is larger if acetylacetone is used both as the solvent and the extracting medium. Evidence concerning the structure of metallic acetylacetones is presented. In particular infrared spectra show that at room temperature at least three molecular forms exist in equilibrium. X-ray evidence is cited to show the six-sided chelate ring is flat, or nearly so. Intermolecular contacts indicate weak Van der Waals forces. (TTT)

13146 EXTRACTION WITH CYCLIC ETHERS. Marko Branica (Institut "Rudjer Bošković," Zagreb). p.60-70 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko–Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

It was found that the extraction of uranyl nitrate goes much better with cyclic ethers than with ordinary ether or similar solvent, based on the "oxonium" mechanism. The separation factor of uranium and thorium is 50 to 80 for these solvents, when the HNO_3 concentration varies from 1 to 2.5 molar. The best solvent for extraction is tetrahydrosilvan, a cyclic ether with a 5-member ring. With 3 M sodium perchlorate, in the presence of a cyclic ether,

about 50% of the uranyl ion present is extracted. It appears, from the results of a continuous extraction experiment, that the transfer of the ion from the aqueous to the organic phase is a very rapid process, and may be advantageous for larger scale separations. (TTT)

13147 EXTRACTION OF INORGANIC COMPOUNDS WITH COMBINATIONS OF EXTRACTION AGENTS. Czesław Deptuła and Stefan Minc (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). p.71-92 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko-Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Polish)

In this work, the extraction of inorganic compounds with solutions of tri-n-octylamine and alkali-phosphoric acid were studied. The uranyl-sulfate employed in the investigation was produced in solutions of the anion complex of sulfuric acid, and potassium dichromate. The discussion of results includes: (1) the influence of H_2SO_4 on the extraction of uranium and chromium with tri-n-octylamine (TnOA) and alkali phosphoric acids, (2) the extraction of uranium in solution of TnOA, alkali phosphoric acids and benzene, (3) the extraction of chromium with solutions of TnOA and alkali phosphoric acids in benzene, and (4) the effect of sulfate concentration on the extraction of chromium. In the extraction of uranium and chromium with tri-n-octylamine and alkali phosphoric acid, at least two effects must be taken into account: (1) the antagonistic influence of the combination of amines and alkali phosphoric acids and (2) the effect of concentrated H_2SO_4 in the extraction of $K_2Cr_2O_7$ and UO_2SO_4 alters the mechanism of extraction giving rise to a synergistic effect. The evidence available at this time is inadequate to determine whether both effects are of the same nature. (TTT)

13148 EXTRACTION OF NIOBIUM AND ZIRCONIUM WITH TRI-ISO-OCTYL-AMINE. F. Krašovec and M. Ostanek (Nuklearni Institut "Jošef Stefan," Ljubljana, Yugoslavia). p.93-100 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko-Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

Niobium and zirconium were extracted with tri-iso-octyl-amine from a hydrochloric acid medium. The separation coefficients were determined as a function of the amine and hydrochloric acid concentration. The value of this coefficient is larger for Zr than Nb, relative to the amine and HCl concentrations. It is concluded that two molecules of amine are found to complex each niobium ion, and one to each zirconium ion. (TTT)

13149 THE EXTRACTION OF URANIUM WITH HIGHLY BASIC ANIONICS IN CARBONATE SOLUTIONS. Wincenty Korpak and Kazmierz Majchrzak (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). p.101-12 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiansko-Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Polish)

The feasibility of uranium extraction from poor ores by anionic absorption is investigated for the locally available, highly anionic preparation SM-X5 obtained from the Polytechnic Cathedral of the Technology of Synthetic Production of Wrocław. It was found that uranium in carbonate solutions can be selectively taken up by SM-X5 even in high concentrations of various anions (CO_3, HCO_3, SO_4, Cl, and NO_3), because of the high affinity of the UO_2-CO_3 complex to this anionic preparation. The taking up of uranium is more effective with small uranium concentrations of the order of 1 gm/l and less. The influence of such parameters as the pH of the solution and the concentration of SO_4, CO_3, NO_3, and Cl ions on the taking up of uranium is also treated. The SO_4 and CO_3 anions have a smaller detrimental effect than the NO_3 and Cl ions, an effect that is reduced by increasing the pH of the solution. (TTT)

13150 THE ELUTION OF URANYL CARBONATE FROM AN ION-EXCHANGE MEDIUM WITH SODIUM CARBONATE AND SODIUM BICARBONATE SOLUTIONS. Vera Keserović (Institut za Tehnologiju Mineralnih Sirovina, Belgrade). p.113-31 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko-Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

It was found that uranium in an ion exchange medium (Dowex 1 × 8, 20-50 mesh) as uranyl tricarbonate complex, can be eluted with convenient concentrations of aqueous solution of sodium carbonate and bicarbonate. With increasing concentration of these salts, the efficiency of elution increases. The optimum constitution of the eluent, for the deposition as well as the degree of concentration of uranium, is found with an aqueous solution consisting of 150 g/l Na_2CO_3 plus 50 g/l $NaHCO_3$. The cheapest eluent is sodium carbonate, followed by a mixture of carbonate and bicarbonate, while sodium bicarbonate is highest. NaCl, in this comparison, would be in third place. Economic comparison of carbonate eluents with chlorides must await pilot plant evaluation. (TTT)

13151 TECHNOLOGICAL PROPERTIES OF HIGHLY BASIC ANIONICS PRODUCED IN POLAND. Wincenty Korpak, Kazimierz Majchrzak (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). p.132-41 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko-Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Polish)

A comparison of the capabilities of uranium absorption was made among three anionic compounds produced in Poland and also Dowex-1-X7.5. The three anionics, SE-X2.5, SE-X5, and SM-X5 were obtained from the Polytechnical Cathedral of the Technology of Production of Synthetics (KTTS) of Wrocław. The first two proved to be extremely poor in taking up uranium while SM-X5 was found to be excellent, proving to be about as effective as Dowex-1-X7.5. (TTT)

13152 EXTRACTION OF URANIUM(VI) AND THORIUM WITH DIARYL PHOSPHORIC ACID ESTERS. F. Krašovec and C. Klofutar (Nuklearni Institut "Josef Stefan," Ljubljana, Yugoslavia). p.143-54 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko-Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

13153 FURTHER EXPERIMENTS ON EXTRACTION OF URANIUM AND IRON WITH ALKALI-PHOSPHORIC ACIDS. Tadensz S. Urbański (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). p.155-66 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko-Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Polish)

This is a continuation of work published in part in Nukleonika, 6: 299(1961) where a study of uranium extraction with dodecylphosphoric acid (DDPA) is reported. DDPA gave high extraction yields of uranium, but also brought out vanadium, aluminum, and iron. The presence of Fe(III) in the extraction of uranium is the most noteworthy and most harmful of the three "impurities" brought out with uranium. The extraction of iron was, therefore, studied in the light of learning more about the conditions that enhance or inhibit the extraction of both uranium and iron, and also in order to learn more concerning the basic reaction that brings out Fe(III). The experiments on the extractions of Fe(III) and U(VI) included studies of (1) the

effect of the concentration of the extraction agent on the coefficient of extraction E^0_w, (2) the effect of Fe(III) concentration on E^0_w for each of three different acid solutions, (3) the influence of other metallic impurities and (4) the pH of the solution on E^0_w. (TTT)

13154 EXTRACTION OF GERMANIUM WITH METHYLENE DIPHOSPHONIC ACID DIOCTYL ESTER AND ITS SEPARATION FROM ARSENIC. D. Grdenić and V. Jagodić (Institut "Rudjer Bošković," Zagreb). p.167-72 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko–Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

With the use of methylene diphosphonic acid dioctyl ester it was found that germanium can be quantitatively extracted from 0.05 to 12N sulfuric acid solutions, and somewhat less well from a hydrochloric acid solution. Trivalent arsenic is not extracted in this way from a H_2SO_4 solution. Germanium can be quantitatively extracted even in the presence of excess As, which presents a method for the separation of these two elements. Germanium cannot be extracted from sulfuric acid solutions with ordinary petroleum. (TTT)

13155 USE OF DIALKYL METHYLENE DIPHOSPHONIC ACID FOR THE EXTRACTION OF URANIUM, THORIUM, VANADIUM, AND TITANIUM. H. Goričan and D. Grdenić (Institut "Rudjer Bošković," Zagreb). p.174-86 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko–Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

By using di-n-butyl and di-n-octyl methylene diphosphonic acid as the extracting medium, tri- and tetravalent metallic ions except Al^{3+} and Cr^{3+} are extracted from solutions with pH < 1. Divalent ions which are extracted are Sn^{2+}, VO^{2+}, and UO_2^{2+}. If the pH lies between 5 and 6 Mn^{2+}, Co^{2+}, Ni^{2+}, and Cr^{3+} are extracted. It is further found that with the di-n-octyl solvent U(IV)–V(IV), Th(IV)–V(IV), as well as the peroxy complexes of V and Ti can be separated. Investigation of the extraction mechanism revealed that the complex $H_4/U/CH_2(nC_8H_{17}OO_2P)_2/4$ contains the uranium. Large excess of U(IV) ions in the aqueous phase leads to precipitation of normal U(IV) salts, which are not soluble in either water or organic solvents. (TTT)

13156 THE EXTRACTION OF METALLIC COMPLEXES OF ORGANIC ACID AMINES. EXTRACTIONS OF URANIUM AND TITANIUM COMPLEXES. Milenko V. Šušić (Institut za Nuklearne Nauke "Boris Kidrič," Belgrade). p.187-205 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko–Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

It is shown that high molecular-weight amines can be used for the extraction of metallic complexes of organic acids. Although preliminary observations were made for many metals and complexing acids, detailed results are given only for the extraction of U and Ti with tri-iso-octyl amine dissolved in xylol, from solutions of ascorbic and oxalic acids. Benzyl and cyclohexyl amines are also examined for the extraction of U and Ti from ascorbic acid solutions. The distribution coefficients are in every case larger than one, except for the extraction of U from ascorbic acid with tri-iso-octyl amine. By increasing the concentration of the complexing medium as well as of the amine, the distribution coefficients increase. In some cases selective extraction can be carried out with these methods. (TTT)

13157 MONO-OCTYL ESTER OF ALPHA ANILINE BENZYLPHOSPHONIC ACID AS A MEANS OF EXTRACTION OF METALS FROM AQUEOUS SOLUTIONS. D. Grdenić and V. Zagodić (Institut "Rudjer Bošković," Zagreb). p.206-22 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko–Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

The extraction of divalent manganese, cobalt, nickel, iron, trivalent iron, arsenic, antimony, bismuth, tetravalent uranium and uranyl ion is quantitatively determined for a petroleum solution of alpha aniline benzylphosphonic acid mono-octyl ester. Curves are given for the extraction of these metals as a function of pH. The complexes were identified by the method of continuous variation of the metal ion concentration in the aqueous phase. They were identified as $[R]_2$ Mn and $[R]_3$ MnH, $[R]_2$ Co, $[R]_2$ Ni, $[R]_3$ Fe, and $[R_4]$ U. Citrate and phosphate buffers were used in the extractions. (TTT)

13158 PRELIMINARY EXPERIMENTS ON THE SEPARATION OF URANIUM, PLUTONIUM AND FISSION PRODUCTS BY SOLVENT EXTRACTION. Ivan I. Gal and Aleksandar Lj. Ruvarac (Institut za Nuklearne Nauke "Boris Kidrič." Belgrade). p.223-46 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko–Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

A miniature pump-mix mixer-settler is described, and preliminary experiments with a Purex-type first cycle are reported. With synthetic U solutions at total flow rates of about 2 ml/min, the average efficiency was about 80%. High yields of Pu were obtained (99.99%), and separation factors of 10^3 and 10^6 were obtained for U/Pu and Pu/U respectively. The decontamination factors for Zr, Nb, and Ru were not satisfactory. The equipment is stable, reliable, and adaptable to various flowsheets. (T.R.H.)

13159 AUTOMATIC AND CONTINUOUS SEPARATION OF RADIONUCLIDES BY COUNTERCURRENT EXTRACTION. Branko Tomažić and Marko Branica (Institut "Rudjer Bošković," Zagreb). p.248-54 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko–Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

An apparatus patterned after Craig (L. C. Craig, D. Craig and Scheibal, "Techniques of Organic Chemistry," 2nd ed., Vol. III, Part I, Interscience, New York, 1956) is described by means of which elements with small distribution coefficients may be separated by countercurrent solvent extraction. The whole process is automated and contains a maximum of 96 flasks. A Geiger counter is used to measure the activity of the top sample. Automatic data output is obtained by means of a ratemeter and recorder. A typical transfer number is 500, and the whole process takes six hours in that case. P^{32} was successfully extracted by this apparatus. (TTT)

13160 URANIUM EXTRACTION FROM QUARTER-TECHNICAL ORES WITH THE AID OF TnOA. M. Goliński and J. Modrzew. p.255-66 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko–Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Polish)

The present investigation is an extension of the work of Cz. Deptuła and W. Korpak reported in Nukleonika 5: 845 (1960) and is aimed at establishing a continuous system of uranium extraction, with TnOA (tri-n-octylamine), from sulphate solutions. The scope of the work was the determination of the fundamental parameters of this process. On the basis of a year's functioning of the apparatus, the following could be reported: (1) the apparatus is simple and can be run by two people, (2) the results corroborate the findings of others; that is, of the advantages of extraction

with amines as compared to extraction with stable anions, (there is a resultant three-fold increase in uranium extraction), and (3) the use of sodium carbonate as an agent of reextraction results in a 50 fold increase, whereas sodium chloride gives a 20 fold increase. (TTT)

13161 THE EXTRACTION OF Fe(III) WITH TRIBUTYLPHOSPHATE FROM A SOLUTION OF BERYLLIUM SULFATE. Milan Lazarević. p.267-75 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko-Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Croatian)

Fe(III) was successfully extracted with a mixture of tributylphosphate and kerosene (1:9) from acid solutions, in the presence of ammonium thiocyanate as a complexing agent. Two-step extraction achieves 99.5% and three-step 99.99% extraction of iron. The degree of extraction is affected by the pH of the solution and concentration of ammonium thiocyanate. Optimum conditions are: pH = 1.8, and molar concentration $NH_4SCN/Fe = 5.7$. The ratio of the aqueous to the organic volume is not very significant; good extraction was achieved for a one-to-one ratio. The purpose of the investigation was to remove iron from beryllium sulfate solutions obtained from leaching beryl ore with sulfuric acid. (TTT)

13162 URANIUM EXTRACTION WITH TRI-n-BUTYL PHOSPHATE FROM HALF-TECHNICAL ORES. J. Modrzew and M. Golinski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). p.276-301 of "Dotyczące Zagadnień Ekstrakcji w Technice Jądrowej. Jugosłowiańsko-Polskie, Kolokwium, Kowary, 7-13 Wrzesień 1961." (In Polish)

The work discussed here is the investigation of the extraction of uranyl nitrate with TBP. It is a fragment of a broader investigation carried out, that of obtaining very pure uranium compounds in technical concentrations of uranium. With the aid of an extraction apparatus employing extractions columns of "Rasotherm" glass filled with coils of glass, the compounds $UO_2(NO_3)_2$ and UO_4 were obtained with the impurities given in a table. SiO_2 and Li were not detected. Rare earths are not indicated. (TTT)

13163 SEPARATION OF HAFNIUM FROM ZIRCONIUM. Lyle Groff Overholser, Charles Julian Barton, Sr., and John William Ramsey (to U. S. Atomic Energy Commission). British Patent 892,764. Mar. 28, 1962.

An economical, continuous, plant-scale process is outlined for separating Hf from Zr and thereby producing Zr with only 100 ppm Hf. The process comprises contacting an acidic aqueous solution of Hf, Zr, Cl^-, and NH_4SCN with a water-immiscible ketone containing HCNS, separating the Hf-enriched organic phase from the Zr-enriched aqueous phase, and treating the aqueous phase with fresh ketone portions. Hexone is preferred as the ketone. The adverse effect of SO_4^{2-} on the extraction of Hf is overcome by Cl^-. (D.L.C.)

13164 PLUTONIUM RECOVERY FROM NEUTRON-BOMBARDED URANIUM FUEL. Raymond H. Moore (to U. S. Atomic Energy Commission). U. S. Patent 3,029,130. Apr. 10, 1962.

A process of recovering plutonium from neutron-bombarded uranium fuel by dissolving the fuel in equimolar aluminum chloride-potassium chloride; heating the mass to above 700°C for decomposition of plutonium tetrachloride to the trichloride; extracting the plutonium trichloride into a molten salt containing from 40 to 60 mole % of lithium chloride, from 15 to 40 mole % of sodium chloride, and from 0 to 40 mole % of potassium chloride or calcium chloride; and separating the layer of equimolar chlorides containing the uranium from the layer formed of the plutonium-containing salt is described. (AEC)

13165 REACTOR FUEL SCAVENGING MEANS. Arthur S. Coffinberry (to U. S. Atomic Energy Commission). U. S. Patent 3,029,142. Apr. 10, 1962.

A process for removing fission products from reactor liquid fuel without interfering with the reactor's normal operation or causing a significant change in its fuel composition is described. The process consists of mixing a liquid scavenger alloy composed of about 44 at.% plutonium, 33 at.% lanthanum, and 23 at.% nickel or cobalt with a plutonium alloy reactor fuel containing about 3 at.% lanthanum; removing a portion of the fuel and scavenger alloy from the reactor core and replacing it with an equal amount of the fresh scavenger alloy; transferring the portion to a quiescent zone where the scavenger and the plutonium fuel form two distinct liquid layers with the fission products being dissolved in the lanthanum-rich scavenger layer; and the clean plutonium-rich fuel layer being returned to the reactor core. (AEC)

13166 URANIUM SEPARATION PROCESS. Ward L. Lyon (to U. S. Atomic Energy Commission). U. S. Patent 3,030,176. Apr. 17, 1962.

A method of separating uranium oxides from PuO_2, ThO_2, and other actinide oxides is described. The oxide mixture is suspended in a fused salt melt and a chlorinating agent such as chlorine gas or phosgene is sparged through the suspension. Uranium oxides are selectively chlorinated and dissolve in the melt, which may then be filtered to remove the unchlorinated oxides of the other actinides. (AEC)

13167 URANIUM RECOVERY FROM NUCLEAR FUEL. Richard C. Vogel and Walton A. Rodger (to U. S. Atomic Energy Commission). U. S. Patent 3,031,261. Apr. 24, 1962.

A process of recovering uranium from a $UF_4-NaF-ZrF_4$ mixture by spraying the molten mixture at about 200°C in nitrogen of super-atmospheric pressure into droplets not larger than 100 microns, and contacting the molten droplets with fluorine at about 200°C for 0.01 to 10 seconds in a container the walls of which have a temperature below the melting point of the mixture is described. Uranium hexafluoride is formed and volatilized and the uranium-free salt is solidified. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstracts 13415, 13423, 13424, 13425, 13426, 13427, 13428, 13429, 13430, 13431, 13433, 13434, 13435, 13444, and 13480.

13168 (AEDC-TDR-62-57) RESEARCH STUDY OF CRYOPUMPING WITH A RADIATION SHIELDED CONDENSER. Raymond W. Moore, Jr. (Little (Arthur D.) Inc., Cambridge, Mass.). Mar. 1962. Contract AF40(600)-899. 107p.

A study was conducted on the empirical design of a cryopumping array. Experiments with a chevron-shielded condenser were carried out and, where possible, the results correlated with analysis. An array constructed from aluminum panels proved to be very serviceable. The array capture probability for nitrogen was about 0.2 and was essentially constant over the range of pressures from 10^{-8} to 5×10^{-6} torr; above 5×10^{-6} torr the capture probability increased with pressure. CO_2 was cryopumped on the chevron shields. Hence, the capture probability was high, varying from 0.7 to 0.94 in the pressure range from 5×10^{-7} to 7×10^{-5} torr. The greatest transmission of radiation through the chevrons to the condenser occurred with a CO_2 deposit on the chevrons and a nitrogen deposit on the condenser, and with infrared radiation incident on the inlet to the array. Even under these conditions less than 2 percent of the incident irradiation was transmitted to the condenser. It is concluded that cryopumping by means of a condenser at 20°K, radiation shielded by surfaces cooled to 77 to 100°K, can provide effective means for removal of nitrogen and all less volatile gases from a vacuum space in the ultra-high vacuum range. (auth)

13169 (CNLM-1730) BRAZE RING MOLD FOR SINTERING AND CASTING. Final Report. S. L. Rogers (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). May 14, 1959. Contract [AT(11-1)-229]. 4p.

Results are presented of an investigation to determine a suitable mold material for use in sintering and casting of braze alloy rings. It was found that #331 electro-graphite provided the best results. (J.R.D.)

13170 (DC-57-4-146) HYDRODYNAMIC AND HYDROSTATIC LUBRICATED BEARINGS WITH PARTICULAR REFERENCE TO AIR BEARINGS–A BIBLIOGRAPHY. M. A. Koenders (General Electric Co. Aircraft Nuclear Propulsion Dept.). April 25, 1957. Contract AT(11-1)-171. 43p.

A search of the unclassified literature and General Electric classified reports was made with reference to the use of air as the lubricating fluid in hydrostatic and hydrodynamic bearing applications. Conclusions and recommendations are included, based on information obtained from references. (auth)

13171 (DC-57-10-98) DESIGN OF PNEUMATIC PRESSURE REGULATING AND QUICK EXHAUST VALVE. Fred W. Schnorr, Jr. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 15, 1957. Contract AT(11-1)-171. 24p.

The shim scram type of actuator in use on Project 100 and Project 101 has a latch mechanism which provides the scram feature of this actuator. Actuators now in operation in Idaho use electrical power to actuate the latch. One of the design considerations that was necessary to convert electrical actuation to pneumatic actuation is reported. The specific problem was the design of a two stage pneumatic exhaust valve incorporating a method of regulating air pressure into a volume that is variable. (auth)

13172 (DC-58-1-89) DESIGN OF A HIGH TEMPERATURE AIR MOTOR. Fred W. Schnorr, Jr. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 8, 1958. Contract [AT(11-1)-171]. 45p.

The basic design and development concepts are presented on a six vane air motor intended for use at elevated temperatures. (auth)

13173 (DC-59-2-149) PERTINENT INFORMATION FOR USE WITH EXPERIMENTAL STRESS ANALYSIS. Robert Clayton (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 5, 1959. Contract AT(11-1)-171. 46).

Information is presented for use in experimental stress analysis evaluations and techniques. Included are typical formulae for determining bridge output in volts and amperes, strain gage calibration by shunt resistor, dynamic strain instrumentation, thermocouples, and properties of materials. (auth)

13174 (DC-59-2-191) A STUDY OF A MECHANICAL MOTION TO PRESSURE TRANSDUCER. W. H. Ward (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 19, 1959. Contract AT(11-1)-171. 32p.

A study of a mechanical-motion-to-pressure transducer was conducted. The device, which consists of two orifices in series, can be used to generate a pressure that is a function of the displacement of a needle in the downstream orifice. The transducer can be designed so that the pressure output signal is a linear function or any other arbitrary function of the needle displacement. Analytical treatment includes both steady-state and linearized transient response. Experimental results to verify theory are also included. A graphical design procedure is described and the appendix includes a general discussion of pneumatic flow through an orifice. (auth)

13175 (DC 59-10-184) CYCLE CALCULATION PROCEDURES FOR AIR–BREATHING JET ENGINES. E. L. Semple (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 14, 1959. Contract [AT(11-1)-171]. 82p.

The thermodynamic and aerodynamic relationships of air-breathing jet engines were examined. Methods of calculating the performance of these engines are discussed. The detailed calculation of design point and off-design performance is described both in theoretical form and in equation form. A simplified method of generating approximate performance is given. (auth)

13176 (NIRL/R/10) FINITE SEPARATION RATIO IN ELECTROSTATIC VELOCITY SEPARATOR DESIGN. N. M. King and R. G. Cox (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England). July 1961. 34p.

The phase space theory of electrostatic velocity separators was extended to cover cases where several beam widths of separation are provided at the selecting slit. Data were derived for $(\bar{p},\pi^-)$ and (K^-,π^-) systems, typifying stable and unstable wanted particles. In the stable case,

these studies yielded practical design estimates, but the investigation is not yet complete for unstable particles. (auth)

13177 (NP-11413) RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. Eighth Quarterly Progress Report, September 16, 1961 through December 15, 1961. R. Novick (Columbia Univ., New York. Columbia Radiation Lab.). Dec. 15, 1961. Contract DA-36-039-SC-78330. 76p. (CU-12-61-SC-78330-Phys.).

A number of projects involving the optical detection of energy level crossings are described, including work on various isotopic species of Zn and Cd. Results are given for the lifetimes of certain of these states. A new experiment is described for the measurement of the hyperfine structure of Li ions. Several optical double-resonance studies are reported, including work on Na and radioactive Cd. New experimental programs are described in microwave spectroscopy of molecules, the production of cryogenic magnets, and a Ru atomic clock. Final results are given for measurements of the $O^{17}H$ free radical. Microwave and optical maser research is discussed. A new experiment for measuring the microwave properties of simulated planetary atmospheres is in progress. (auth)

13178 (NP-11582) LOW VISCOSITY BEARING STABILITY INVESTIGATION. Space Power Operation First Quarterly Project Status Report for Period Ending February 9, 1962. (General Electric Co. General Engineering Lab., Schenectady, N. Y. and General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). 66p.

A combined analytical and experimental effort is reported concerned with selection and development of bearing configurations which promise stable operation up to the high speeds typical of space turbomachinery (35,000 rpm). Emphasis in the investigations is placed on experiment and evaluation. The experimental tool used is a high speed test rig, precision made for interchangeability of a large variety of bearing configurations and rotors. It is equipped with the most refined instrumentation to record rotor and bearing motions, as well as other parameters affecting bearing operation. The testing will be carried out at room temperature with lubricants which simulate the low viscosity and lubricity of liquid metals at operating temperatures. Using the bearing stiffness as a first approximative stability criterion, analysis of various bearing types to determine zero load radial bearing stiffnesses is reported. The load carrying capacity at a minimum film thickness of 0.0005 in. of the bearing types considered was also calculated. Detailed design analysis of several test rig components was completed. Considerable efforts were spent to determine the natural frequencies of various shaft-bearing systems. Based on the results, a 1.25 in. diameter test shaft was selected. The over-all layout of the test rig was completed and detailing of test rig components was started. Capacitance gauges were checked out under simulated operating conditions including water and air. (auth)

13179 (ORNL-2811) DECONTAMINATION TESTING OF HIGHLY CONTAMINATED PROTECTIVE COATINGS. G. A. West and C. D. Watson (Oak Ridge National Lab., Tenn.). May 6, 1960. Contract W-7405-Eng-26. 26p.

Decontaminability measurements of 34 protective coatings (primarily vinyls and epoxies) and 10 comparative control surfaces (metals, glass, and plastics) highly contaminated with either mixed fission products from typical Purex waste or Oak Ridge National Laboratory Thorex waste did not indicate any unusual improvement over coatings tested in 1950 (AECD-2296). These measurements and chemical resistance tests were made of the protective coatings in common acids, alkalis, and deionized water at 81 and 120°F as a guide in the selection of coatings for radiochemical plant applications and to determine if coatings containing water vehicles could be substituted for coatings containing more hazardous organic solvent vehicles. Vinyl base coatings were superior in both decontaminability and chemical resistance. The two water-vehicle coatings evaluated were markedly inferior to organic-vehicle vinyls. A vinyl "wallpaper" was decontaminated poorly with the reagents used. Water and 3M HNO_3 removed Purex contaminants relatively efficiently but were relatively ineffective for the removal of Thorex contaminants. Coatings determined to be sufficiently decontaminated from Purex waste by a water flush and acid scrub and to be of superior resistance to common acids and alkalis are given. (auth)

13180 (ORNL-TM-79) WATER TEST DEVELOPMENT OF THE FUEL PUMP FOR THE MSRE. P. G. Smith (Oak Ridge National Lab., Tenn.). Mar. 27, 1962. Contract W-7405-eng-26. 52p.

A vertical centrifugal sump-type pump utilizing commercially available impeller and volute designs was selected to circulate the fuel salt in the Molten Salt Reactor Experiment (MSRE). Tests were conducted in water to determine the adequacy of the pump design, to assist design of the prototype fuel pump, and to investigate the effectiveness of xenon removal with high velocity liquid jets contacting sweep gas in the pump tank. Hydraulic head characteristics were within +1 to –3 ft of manufacturers data for a given constant speed. Adequate and necessary provisions were devised to control the liquid and gas bubble behavior in the pump tank. The results of priming and coastdown tests are reported. During the gas removal tests, the fuel, xenon, and helium in the MSRE were simulated with distilled water, carbon dioxide, and air, respectively. The best configuration removed carbon dioxide from water at approximately 99% of the ideal removal rate when the stripping flow was 65 gpm and the sweep gas flow rate was 4 scfm. (auth)

13181 (PWAC-111) TESTING OF HIGH SPEED GEARS FROM APRIL 1952 TO SEPTEMBER 1953. A. H. King (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). June 1, 1954. Contract [AT(11-1)-229]. 11p.

The tests were conducted to determine the effects of increased pitch line velocities (from 10,000 to 34,000 ft/min) on gear teeth. The factors observed and measured were beam strength, wear, pitting, and scoring. Results and conclusions are given and it is pointed out that further tests are required before the information can be considered anything more than tentative. (J.R.D.)

13182 (TID-13998) THE APPLICATION OF GAS-LUBRICATED BEARINGS TO HIGH-SPEED TURBOMACHINERY. Quarterly Technical Report Covering Period April 1, 1961 to June 30, 1961. M. W. Eusepi and D. D. Fuller (Franklin Inst. Labs for Research and Development, Philadelphia). Contract AT(30-1)-2512. 34p. (Q-A2392-3-1)

Activities in a program to develop design information for gas-lubricated bearings are reported. Re-design of the tilting-pad journal bearings for an existing gas-bearing rotor brought to light various limitations. The decision was made to build new simplified gas-bearing rotors which should be more amenable to laboratory instrumentation and examination. Design and fabrication work on such bearings are described. (J.R.D.)

13183 (TID-15140) QUARTERLY PROGRESS REPORT NO. 64 [ON ELECTRONICS]. H. J. Zimmermann, G. G. Harvey, and W. B. Davenport, Jr. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Jan. 15, 1962. Contracts DA36-039-sc-78108; AT(30-1)-1842; AF19(604)-5992; and AF33(616)-7624. 376p.

Research activities are reported on physical electronics, soft x-ray spectroscopy, physical chemistry, low temperature physics, statistical thermodynamics, microwave spectroscopy, masers, nuclear magnetic resonance, microwave electronics, molecular beams, radio astronomy, physical acoustics, and noise in electron devices. Investigations are also reported in plasma dynamics. Research in communication sciences and engineering is reported on modulation theory and systems, statistical communications theory, process analysis and synthesis, processing and transmission of information, artificial intelligence, speech communication, mechanical translation, linguistics, communications biophysics, neurophysiology, neurology, sensory aids research, circuit theory and design, network synthesis, computer research and stroboscopic research. (J.R.D.)

13184 (TIM-499) FORCED CONVECTION LIQUID METAL INPILE LOOP LIQUID METAL VOLUME CALCULATION. C. R. Nelson (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Sept. 26, 1958. Contract [AT(11-1)-299]. 13p.

Calculation results concerning the Pratt and Whitney inpile loop volume are presented. Data are tabulated on the maximum and minimum values for the room temperature and operating temperature volumes for each section of the liquid metal circuit from which total volumes can be obtained. Recommendations concerning volume minimums and maximums are included. (J.R.D.)

13185 (WAPD-AD-TH-544(Del.)) DETERMINATION OF AN AVERAGE THICKNESS FOR RECTANGULAR CHANNELS: A DATA REDUCTION PROCEDURE. Elaine H. Burr and M. Troy (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Oct. 7, 1959. Contract AT(11-1)-GEN-14. 12p.

In the absence of a reliable mechanical method of determining channel thicknesses for rectangular channels, a scheme was developed whereby an indirect measure of the average channel thickness is obtained. The method is based on the measurement of isothermal pressure drop in the channel. The computer code written to facilitate calculations of channel thickness is discussed. (M.C.G.)

13186 (AEC-tr-5049) INVESTIGATING THE CRITICAL VELOCITY OF STRIPPING OF THE MOISTURE FILM FROM THE WALLS OF STEAM PIPES. N. A. Mozharov. Translated from Teploenergetika, 6: No. 2, 50-3(1959). 8p.

Results of an investigation are presented on determination of the critical velocity for film stripping from wet-stream-carrying pipes. A formula for the critical velocity is developed which can be used to determine the maximum permissible load on a separator and to analyze the operation of steam extracting devices. (J.R.D.)

13187 (FTD-TT-61-169) SOME CHARACTERISTICS OF HIGH-FREQUENCY ION SOURCES. Yu Kou (Yea Gu). Translated from Wu Li Hsüeh Pao, 16: 107-10(Feb. 1960). 7p.

The effects of some principal characteristics such as the gas pressure at a high-frequency ion source, the strength of the magnetic field, the collector potential, the r-f power, etc., upon the ion current were studied. A maximum ion current of 1.35 ma was obtained with a collector 1.8 mm in diameter, a collector channel 9.5 mm long, and a magnetic field of 150 oersteds. (auth)

13188 (FTD-TT-61-333) REASONED TECHNOLOGY OF MANUFACTURING TUBE-DRAWING MACHINERY (CHAPTER III). M. B. Bisk. Translated from p.37-49; 52-65 of "Ratsional'naya Tekhnologiya Trubovolochil'nogo Instrumenta" (A publication of Metallurgizdat, Sverdlovsk, USSR, 1960). 26p.

The manufacture of tube drawing tools from metalloceramic alloys is treated. The preparation of dies is discussed. The following surface treatment methods for hot-pressed die sets are considered in some detail: electrosparking, electrolytic, electro-abrasive, and ultrasonic. (D.L.C.)

13189 PRESSURE SEALS FOR REACTOR MECHANICAL DRIVES. DEVELOPMENT AND APPLICATION FOR HUNTERSTON AND TOKAI MURA STATIONS. P. R. Rogers. Nuclear Eng., 7: No. 70, 110-13(Mar. 1962).

Details are given of the testing and development carried out on seals for rotating and reciprocating drives for various items of equipment associated with reactor gas circuits, charging machines, and service machines. (N.W.R.)

13190 SIMILARITY RELATIONS FOR ELECTROMAGNETIC PUMPS. F. G. Hammitt (University of Michigan, Ann Arbor) and J. L. Summers. Nuclear Power, 7: No. 71, 61-3(Mar. 1962).

Theoretical comparisons of the performance of the a-c conduction-type electromagnetic pump with liquid mercury and sodium–potassium systems are made using simplified electromagnetic theory, and tests are quoted showing that the performance curves are analogous to those of a centrifugal pump if rotating speed is substituted for by voltage. The analogy, however, is not complete because of the somewhat different role of density in the relations. These relations provide useful estimates of actual performance as long as good wetting is achieved. (N.W.R.)

13191 WATER COOLED MAGNETS. F. Bitter (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 33: 342-9(Mar. 1962).

A discussion is given of the construction of water-cooled solenoids at power levels ranging from 1 to 100 Mw and with cylindrical inner working spaces having radii ranging from 1 to 10 cm. A first limitation is due to the fact that the power density in the magnet cannot exceed a value set by the surface cooling rate allowable in the water passages. Present designs go up to a power density of 1.5×10^4 w/cm^3 and a surface cooling rate of 1.5×10^3 w/cm^2. With these limitations, useful coils can be built operating at power levels ranging from 1 to 10 Mw and giving fields ranging from 100 to 250 kilogauss. In the range of 200 to 300 kilogauss, Zr–Cu or Cr–Cu alloys may be used to avoid plastic deformation at the inner surface. The strengthening and cooling of coils to operate at higher power levels is discussed. A preliminary design is presented for a high precision magnet for nuclear magnetic resonance experiments. (auth)

13192 THE USE OF RADIOACTIVE ISOTOPES IN ENGINEERING. K. Detzer (Isotope-Studiengesellschaft e. V., Frankfurt am Main). VDI Zeitschrift, 104: 182-5 (Feb. 1, 1962). (In German)

The industrial uses of radioisotopes are reviewed from work accomplished over the past year. The review contains information on the following topics: bench test

measurements; thickness and density measurements; moisture determinations; quantitative analysis; radiography; tracer techniques; radioisotope control, checking, and protective methods; chemical utilization of the radiation effect; use in radiation detectors; and luminous paints and isotope batteries. The bibliography contains 54 references. (N.W.R.)

13193 IMPROVEMENTS IN AND RELATING TO ELECTRICAL REMOTE CONTROL APPARATUS. (to Zaklady Wytworcze Glosnikow "Tonsil"). British Patent 889,319. Feb. 14, 1962.

An electric remote manipulator, also called an "artificial hand," is designed for carrying out movements in any direction and at any length. The manipulator contains a transmitter and a receiver, both identical and each comprising four selsyns mounted in a cascade with their axes perpendicular to each other. The fourth selsyn translates rotational movement into linear movement. (D.L.C.)

13194 IMPROVEMENTS IN OR RELATING TO MECHANICAL HANDLING EQUIPMENT INCLUDING A CARRIAGE AND A GRAB. Kenneth Thomas Peers Langdon (to Babcock & Wilcox Ltd.). British Patent 889,709. Feb. 21, 1962.

Mechanical handling equipment is designed for removing debris from the pressure vessels of gas-cooled, graphite-moderated reactors. The equipment includes a carriage and a grab for raising and lowering a load mounted on the carriage. The carriage is arranged to carry a load-supporting means which is projectable to an advanced position below the grab. (D.L.C.)

13195 IMPROVEMENTS RELATING TO NEUTRON SOURCES. Clive Frederick George Dupen (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 891,806. Mar. 21, 1962.

A neutron source is designed for use in a reactor in order to maintain a minimum power level in the shutdown state so that the instruments continue to operate. The source comprises two concentric tabular members, the inner member containing Sb^{124} and the outer member Be^{9}, and when it is desired to inactivate the source, the inner member is lifted from the outer member. A hoist is provided for removing the inner member from the reactor. (D.L.C.)

13196 IMPROVEMENTS IN HIGH VACUUM PUMPS. Paul Garlin and Pierre Prugne (to Commissariat a l'Energie Atomique). British Patent 892,122. Mar. 21, 1962.

A vacuum pump is designed which uses gettering and condensation to give high pumping speeds at low pressure for all gases, including air and rare gases. The pump comprises a pump body, means for vaporizing a getter in the body, a gas trap chamber for condensing the gas not extracted by gettering, and means for evacuating the gas trap chamber. (D.L.C.)

13197 IMPROVEMENTS IN OR RELATING TO HOISTING DEVICES. William Joseph Sidebottom, Leslie Maurice Fletcher, and Robert Alec Lewis (to United Kingdom Atomic Energy Authority). British Patent 892,603. Mar. 28, 1962.

A hoist is designed for lowering an ion chamber from a branch pipe in a reactor pressure vessel into the core for neutron flux measurements. The hoist comprises a tubular housing, a winding drum disposed therein, and pully and guide means for winding or unwinding the cable on or from the drum. The drum is arranged with its axis parallel to that of the housing so that the housing is compact and can be accommodated in a standpipe. (D.L.C.)

13198 SODIUM–WATER HEAT EXCHANGER. Wallace R. Simmons and Leonard J. Koch (to U. S. Atomic Energy Commission). U. S. Patent 3,029,796. Apr. 17, 1962.

A heat exchanger comprising a tank for hot liquid and a plurality of concentric, double tubes for cool liquid extending vertically through the tank is described. These tubes are bonded throughout most of their length but have an unbonded portion at both ends. The inner tubes extend between headers located above and below the tank and the outer tubes are welded into tube sheets forming the top and bottom of the tank at locations in the unbonded portions of the tubes. (AEC)

13199 VALVE. Adele Marion Arkelyan and C. L. Rickard (to U. S. Atomic Energy Commission). U. S. Patent 3,029,842. Apr. 17, 1962.

A gate valve for controlling the flow of fluid in separate concentric ducts or channels by means of a single valve is described. In one position, the valve sealing discs engage opposed sets of concentric ducts leading to the concentric pipes defining the flow channels to block flow therethrough. In another position, the discs are withdrawn from engagement with the opposed ducts and at the same time a bridging section is interposed therebetween to define concentric paths coextensive with and connecting the opposed ducts to facilitate flow therebetween. A wedge block arrangement is employed with each sealing disc to enable it to engage the ducts. The wedge block arrangement also facilitates unobstructed withdrawal of the discs out of the intervening space between the sets of ducts. (AEC)

13200 FLUID PURIFIER AND SEALING VALVE. W. F. Swanton (to U. S. Atomic Energy Commission). U. S. Patent 3,031,174. Apr. 24, 1962.

An improved cold trap designed to condense vapors and collect foreign particles in a flowing fluid is described. In the arrangement, a valve is provided to prevent flow reversal in case of pump failure and to act as a sealing valve. Provision is made for reducing the temperature of the fluid being processed, including a pre-cooling stage. (AEC)

Heat Transfer and Fluid Flow

Refer also to abstracts 12830, 12831, 13068, 13069, 13070, 13071, and 14354.

13201 (AERE-R-3389) THE ACCURACY OF HEAT TRANSFER MEASUREMENTS IN A HIGH PRESSURE SLURRY LOOP. I. H. Newson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1961. 34p.

The suitability of the high temperature (300°C) high pressure (1500 psia) thoria slurry circulating loop for obtaining reasonably accurate heat transfer measurements was considered. It is concluded that measurements of the heat transfer coefficient should be accurate to within ±25%. Other points of particular importance with respect to the pumping of thoria slurries are also discussed. These are the transition region in non-Newtonian flow, entrance effects, and the settling out of thoria particles. (auth)

13202 (BM-RI-5888) IN SITU DETERMINATION OF THE DYNAMIC ELASTIC CONSTANTS OF ROCK. Harry R. Nicholls (Bureau of Mines. Applied Physics Research Lab., College Park, Md.). Dec. 1960. 20p.

Presented at International Symposium on Mining Research, Missouri School of Mines and Metallurgy, Rolla, Mo., Feb. 22-25, 1961.

A simple economical method was developed for determining the in situ longitudinal and shear velocities in rock from which its elastic constants can be calculated. By detonating small charges of high explosives in shallow drill holes near a free surface, both longitudinal and shear waves were generated simultaneously. Accelerometers and velocity gages mounted to the rock surface were used to record the arrival time for both waves over travel path lengths from 50 to 450 feet. Measurements were made in two rock types. From the arrival time measurements, the longitudinal and shear wave velocities were calculated. From these velocities and the density of the rock, the elastic constants were calculated. (auth)

13203 (CNLM-1802-16) BOILING HEAT TRANSFER OF LIQUID METALS. A Literature Search. Elizabeth A. Cernak, comp. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Oct. 3, 1960. Contract [AT(11-1)-229]. 3p.

A partially annotated bibliography on boiling heat transfer in liquid metals is presented. Emphasis is placed on liquid Na, K, and Ru. Sources used include Abstracts of Classified Reports and Nuclear Science Abstracts from 1950 to 1960. (J.R.D.)

13204 (DC-56-11-42) SURFACE TEMPERATURE OF WATER COOLED ALUMINUM PLATE IN CONTACT WITH A HIGH TEMPERATURE REFRACTORY BAR. S. E. Eckard (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 5, 1956. Contract AT(11-1)-171. 19p.

Curves are presented showing the surface temperature distribution on the air side of a water cooled Al plate. The heat source for this temperature distribution is a SiC bar in contact with the plate. (auth)

13205 (DC 57-10-56) INVESTIGATION OF THE AERODYNAMIC PERFORMANCE OF A SERPENTINE DUCT. C. R. Weeden, R. E. Christenberry and R. F. Cook (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). October 4, 1957. Contract AT(11-1)-171. 22p.

Results of experimental investigations made to determine the aerodynamic characteristics of a serpentine duct and of a diffuser at the exit of the duct are presented. The wavelengths of the wiggles in the passages were not constant with passage length, and air was introduced at one end and then at the other end by reversing the duct in the test rig to determine the effect of flow direction in the duct. The friction factor was found to be higher when the duct was tested with the short wave lengths toward the downstream end of the duct than when they were at the upstream end of the duct. (auth)

13206 (EURAEC-44) RESULTS OF WET STEAM COOLING EXPERIMENTS: PRESSURE DROP, HEAT TRANSFER AND BURNOUT MEASUREMENTS IN ANNULAR TUBES WITH EXTERNAL HEATING. Special Report No. 4. N. Adorni, S. Bertoletti, J. Lesage, C. Lombardi, G. Peterlongo, G. Soldaini, F. J. Weckermann, and R. Zavattarelli (Centro Informazioni Studi Esperienze, Milan). Dec. 1960. Work Performed under United States-Euratom Joint Research and Development Program. Contract [002-59-11RDI]. 88p. (CISE-R-30)

Data obtained at the Piacenza heat transfer facility are presented tabularly concerning pressure drops with power and with zero power, heat transfer coefficients, and burnout heat fluxes. Graphic data are included on pressure drops with zero power vs. mean steam quality and for burnout heat fluxes vs. steam quality at burnout. (J.R.D.)

13207 (NAA-SR-6769) AN EXPERIMENTAL STUDY OF SODIUM POOL BOILING HEAT TRANSFER. R. C. Noyes (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 30, 1962. Contract AT(11-1)-Gen-8. 37p.

A saturated Na pool boiling experiment is described in which the test section was a horizontal, $\frac{3}{8}$-in.-diameter, electrically heated cylinder. Measurements of surface temperature and heat flux during nucleate boiling were made at pool temperature between 1200 and 1500°F and at heat fluxes up to 800,000 Btu/hr-ft^2. Burnout heat flux measurements were made at pool pressures between 0.5 and 1.5 psia. Empirical correlation of the nucleate boiling data showed heat transfer coefficients somewhat higher than previous predictions. A new nondimensional burnout correlation is derived which brings the Na measurements into agreement with published burnout values for water and various organics. This correlation predicts a burnout heat flux for Na pool boiling of 1.9×10^6 Btu/hr-ft^2 at one atmosphere, and it is recommended for burnout predictions for Na and other wetting liquid metals at pressures which are low relative to their critical pressure. (auth)

13208 (NAA-SR-Memo-6942) FLOW STABILITY LOOP—NUCLEATE BOILING HEAT TRANSFER WITH ORGANIC COOLANT. F. Halfen (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 7, 1961. Contract [AT(11-1)-Gen-8]. 8p.

Nucleate boiling heat transfer experiments were conducted using the flow stability loop. The test section and instrumentation were the same as used in previous forced convection experiments with this loop. The organic coolant, isopropyl diphenyl, was used. Results were compared with the nucleate boiling heat transfer model used in FUGUE, Levy's generalized boiling heat transfer equation. An experimental correlation coefficient, B_L, was determined as a function of pressure. Excellent agreement was obtained between the experimental temperature differences and the values calculated with the Levy equation using the experimental correlation coefficient. The following ranges of variables were studied: heat flux, 40,000 to 100,000 Btu/hr ft^2; coolant velocity, 7 to 13 ft/sec; outlet pressure, 20 to 35 psia; wall superheat, 38 to 54°F; and coolant subcooling, 0 to 20°F. In all cases the experimental and calculated wall superheat temperatures agreed within 3°F. (auth)

13209 (NAA-SR-Memo-6946) EFFECT OF ADDITIVES ON BOILING HEAT TRANSFER AND CRITICAL HEAT FLUX. A Literature Survey. C. V. Metzler (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 14, 1961. Contract [AT(11-1)-Gen-8]. 10p.

A literature review was made of the effect of additives on boiling heat transfer and critical heat flux. Published data show that certain additives can greatly change the rate of boiling heat transfer and the critical heat flux. Additives which were found to increase the critical heat flux of some organic fluids include both high and low volatility materials. For polyphenyl coolants, suggested additives for initial investigation are benzene and other ring type compounds, and surface active agents and other high molecular weight compounds. (auth)

13210 (NASA-TR-R-132) ESTIMATED VISCOSITIES AND THERMAL CONDUCTIVITIES OF GASES AT HIGH TEMPERATURES. Roger A. Svehla (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). 1962. 141p.

Viscosities and thermal conductivities, suitable for heat-transfer calculations, were estimated for about 200 gases in the ground state from 100 to 5000°K and 1 atm pressure. Free radicals were included, but excited states and ions

were not. Calculations for the transport coefficients were based upon the Lennard-Jones (6-12) potential for all gases. Intermolecular force constants for this potential were obtained from experimental viscosity data, or were estimated when data were not available. The same set of constants was used to calculate both viscosity and conductivity. A correction for exahange between internal and translational energies was made for thermal conductivities of polyatomic gases. (auth)

13211 (TID-14632) FORCED CONVECTION BOILING STUDIES. FINAL REPORT [ON] FORCED CONVECTION VAPORIZATION PROJECT. V. E. Schrock and L. M. Grossman (California. Univ., Berkeley. Inst. of Engineering Research). Nov. 1, 1959. For California. Univ., Livermore. Lawrence Radiation Lab. Contract [W-7405-eng-48]. 123p.

Local heat transfer coefficients and pressure gradients were measured for bulk boiling of water in forced flow in round tubes with internal diameter ranging from 0.1162 to 0.4317 in. and lengths of 15 to 40 in., heat fluxes of 6×10^4 to 1.45×10^6 BTU/hr ft^2, mass fluxes of 49 to 911 lb/sec ft^2, exit qualities of 5 to 57% and at pressures ranging from 42 to 505 psia. The pressure gradients are correlated within 30% in terms of modified Lockhard-Martinelli parameter, while the Nusselt number is correlated within 40% by a combination of the Lockhard-Martinelli X_{tt} and a parameter called the boiling number, $Bo = (q/A)/(Gh_{fg})$. Apparently X_{tt} expresses the effect of forced convection while the boiling number relates to the nucleate boiling contribution. A study of the influences of nucleate boiling of a subcooled liquid on the pressure gradient in forced flow was also conducted. (auth)

13212 (TIM-483) FORCED CONVECTION LIQUID METAL INPILE LOOP LIQUID METAL PRESSURE DROP CALCULATIONS. C. W. Johnson and R. Dreisbach (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Nov. 3, 1958. Contract [AT(11-1)-229]. 17p.

Calculation method and results on pressure drop are reported through the liquid metal flow circuit as a function of experiment geometry in the PW-19 in-pile-loop. A summary is presented of calculated pressure losses in the loop, starting at the pump diffuser discharge and proceeding around to the pump intake. (J.R.D.)

13213 (TIM-483(Suppl. 1)) NAK PRESSURE DROP CALCULATIONS FOR THE PRATT & WHITNEY FORCED CONVECTION LIQUID METAL INPILE LOOP, PW-19 INCORPORATING THE MARK II CERAMIC TEST SPECIMEN. W. Ackerman (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middleton). Apr. 14, 1959. Contract [AT(11-1)-229]. 20p.

Theoretical calculations are presented concerning pressure losses caused by configuration and geometry in the Pratt and Whitney forced convection liquid metal in-pile loop. Also included is an analysis of the theoretical pressure drop across the Mk. II 3-tier 54-pin ceramic fuel element test specimen. NaK temperatures in the experiment vary from 1500 to 1600°F at design conditions. (J.R.D.)

13214 (AEC-tr-5042) DIFFUSION KINETICS UNDER TURBULENT CONDITIONS OF MIXING. A. I. Fedorova and G. L. Vidovich. Translated by Lydia Venters (Argonne National Lab., Ill.) from Doklady Akad. Nauk S.S.S.R., 109: 135-8(1956). 7p.

An experiment is described to determine the temperature coefficient of convective diffusion under turbulent conditions of mixing and to compare it with the temperature coefficient under laminar conditions. It is concluded that the temperature dependence of diffusive flow changes is determined by the temperature dependences of the diffusion coefficient and kinematic viscosity. (J.R.D.)

13215 HEAT TRANSFER FROM THE SURFACE OF A STEAM BUBBLE IN TURBULENT SUBCOOLED LIQUID STREAM. S. G. Bankoff and J. P. Mason (Northwestern Univ., Evanston, Ill.). A.I.Ch.E. Journal, 8: 30-3(Mar. 1962).

Turbulent heat transfer coefficients were measured at the surface of single bubbles formed by injecting steam into a subcooled water stream of atmospheric pressure. Depending upon the steam flow rate (0.4 to 1.5 g/min), the water temperature (80 to 180°F), and the water velocity (0.9 to 7.2 ft/sec) the bubbles ranged from small, smooth, ellipsoidal bubbles, similar to those observed in highly subcooled nucleate boiling, to large, irregular bubbles which oscillated in size. The bubble frequencies were in the range 200 to 2500 cycles/sec and the surface heat transfer coefficients 13000 to 320,000 Btu/(hr)(sq ft)(°F). Because of these exceptionally high heat transfer coefficients a significant fraction of the total heat flow in Gunther's subcooled boiling experiments is estimated to be attributable to latent heat transport. (auth)

13216 A NOTE ON LATENT HEAT TRANSPORT IN NUCLEATE BOILING. S. G. Bankoff (Northwestern Univ., Evanston, Ill.). A.I.Ch.E. Journal, 8: 63-5(Mar. 1962).

A simple one-dimensional transport calculation is made which indicates that latent heat transport, by simultaneous evaporation and condensation at different portions of the bubble surfaces, can account for the major portion of the total heat flux in the neighborhood of the departure from subcooled nucleate boiling (burnout). This differs from the previously held view that the stirring action of the bubbles accounted for most of the heat flow in subcooled nucleate boiling. Other evidence is discussed which favors the latent heat transport theory. (auth)

13217 A METHOD FOR IMPROVING HEAT TRANSFER TO A BOILING FLUID. C. W. Cowley, W. J. Timson, and J. A. Sawdye (Linde Co., Tonawanda, N. Y.). Ind. Eng. Chem., Process Design Develop., 1: 81-4(Apr. 1962).

Heat transfer rates from thermally conductive solids to boiling liquids can be improved by coating the solid with an insulator having sufficient insulation value to adjust the temperature difference between the coated solid and the liquid nitrogen to a value where more efficient heat transfer will result. The method is particularly applicable to conditions where the solid is at a much higher temperature than the boiling liquid. Under these conditions stable film boiling occurs. The solid is then blanketed by a stable, highly insulating layer of vapor resulting in a low heat transfer rate. By coating the solid with an insulator, it is possible to alter the regime of boiling from stable film boiling to unstable film or nucleate boiling where higher heat transfer rates are possible. (auth)

13218 FLOW RATE DETERMINATION BY THE PULSE COUNTING METHOD. A CONTRIBUTION TO THE INVESTIGATION OF LIQUID CURRENTS WITH THE HELP OF RADIOACTIVE INDICATORS. W. Herrmann, H.-K. Bothe, and H. Ohlsen (Institut für Angewandte Radioaktivität, Leipzig). Isotopentechnik, 1: 232-6(Nov. 1961). (In German)

The determination of flow rates in tubes by the pulse counting method is described. For measurements on primary and fractional currents, counters were used as detectors and Na^{24} as the tracer. The effects of dead time and statistical scattering on the results were investigated

at different activities and injection times. Flow rates in a streaming range from Re = 225 to 60,000 were determined, the values obtained were discussed, and the consequences for the application of the pulse counting method were indicated. (tr-auth)

13219 GROWTH RATE OF VAPOUR BUBBLES IN WATER AND IN A BINARY MIXTURE BOILING AT ATMOSPHERIC PRESSURE. W. R. Van Wijk and S. J. D. Van Stralen (Landbouwhogeschool, Wageningen, Netherlands). Physica, 28: 150-71(Feb. 1962). (In English)

The growth rate of vapor bubbles generated on an electrically heated wire in water and in a mixture of methylethylketone and water (4.1 wt % of MEK) was studied using a high speed motion picture camera. A smaller growth rate in the mixture than in pure water was expected at the same superheat, as the most volatile component (MEK) is rapidly exhausted in the liquid near the bubble. Further growth is then limited by the relatively slow process of diffusion of MEK toward the bubble boundary. A smaller growth rate was actually observed for free bubbles. A previously derived asymptotic law $r = C_1\delta\sqrt{t}$, in which r (cm) is the radius of a free, spherically expanding vapor bubble in an infinite volume of a superheated pure liquid, C_1 a constant, δ(°C) the initial superheat of the liquid and t (sec) the time elapsed since first formation of the bubble, predicts $C_1 = 0.23$ for water at atmospheric pressure. In the present investigation $C_1 = 0.29$ was found for ascending free vapor bubbles in water and $C_1 = 0.06$ in the mixture. However, the initial growth rate of bubbles, attached to the heating surface, was much higher and corresponded to the relatively large wire superheat. Several bubbles were found to vibrate. (auth)

13220 LIQUID SODIUM FLOW FACILITY FOR MAGNETO-FLUID-DYNAMIC RESEARCH. Tony Maxworthy (Jet Propulsion Lab., Pasadena, Calif.). Rev. Sci. Instr., 32: 1260-1(Nov. 1961).

A system was designed and built to study, in a logical fashion, interactions that result from the coupling of electromagnetic and fluid dynamic phenomena. The system is of the same generic type as the wind tunnel. A conducting fluid (liquid sodium at 150°C) is circulated in a closed loop and passes through the following components during its motion: a free surface centrifugal pump, an electromagnetic flow meter, a wide angle diffuser and settling chamber, a nozzle, the test section, and a narrow angle diffuser. The arrangement of the components and the fluid path is illustrated. (P.C.H.)

13221 INTERNATIONAL DEVELOPMENTS IN HEAT TRANSFER. 1961 International Heat Transfer Conference, August 28–September 1, 1961, Boulder Colorado, U.S.A. and January 8-12, 1962, Westminster, London, England. Parts I through V. New York, The American Society of Mechanical Engineers, 1961.

Papers presented at the International Heat Transfer Conference at Boulder, Colorado and later at London are given. The 124 papers are divided into 5 parts. Topics covered include: heat conduction and thermoelectric effects; heat transfer in equipment; boiling and burnout, condensation, and two-phase flow; high speed flows, aspects of external convection, vibrations and pulsating flows; internal and duct flow; mass transfer, packed and fluidized beds; radiation, thermal properties and instrumentation; and free convection. Separate abstracts were prepared for 52 papers. (M.C.G.)

13222 THE METHOD OF FINITE INTEGRAL TRANSFORMS IN HEAT TRANSFER PROBLEMS. Stanley Kaplan (Westinghouse Electric Corp., Pittsburgh) and George Sonnemann. p.1-6 of "International Developments in Heat Transfer. Part I." New York, The American Society of Mechanical Engineers, 1961. (WAPD-T-1291)

The idea contained in the finite Fourier and Hankel transforms was here applied to a general heat conduction problem and a transform identified which converts that problem into an uncoupled infinite set of ordinary differential equations. When a different finite transform was used, the set of transformed equations was coupled. As an illustration, the solution to a problem of temperature distribution in a laminar flow was obtained formally and some of the eigenfunctions needed for a numerical solution are tabulated. (auth)

13223 HEAT TRANSFER FROM THE URANIUM FUEL TO THE MAGNOX CAN IN A GAS-COOLED REACTOR. P. D. Sanderson (English Electric Co., Ltd., Leicestershire, Eng.). p.53-64 of "International Developments in Heat Transfer. Part I." New York, The American Society of Mechanical Engineers, 1961.

The uranium-magnox interface thermal resistance was measured under various conditions to obtain knowledge of the mechanism of heat transfer at such an interface. The interface resistance C cm^2 $watt^{-1}$ was plotted vs $\log_{10}$ $(p/M \times 10^3)$ for data obtained for the temperature range 150 to 450°C and for contact pressures of 47, 100, 150, and 285 psi. Results were obtained in Ar and He at 17.7 psia and in vacuum. Interface resistance vs interface gas pressure is shown at a magnox interface temperature which was maintained approximately constant at 200°C. The effects of uranium oxide and nitride film thickness were determined. Results indicated that a transition took place as the ratio of the actual contact area to the nominal contact area, p/M, was increased, from conditions where the gas conductance predominated to those where the contact conductance predominated and the presence of an interface gas had virtually no effect on the over-all heat transfer. (M.C.G.)

13224 THERMOELECTRIC GENERATOR EFFICIENCY. Richard L. Sampson (Minneapolis-Honeywell Research Center, Hopkins, Minn.). p.86-92 of "International Developments in Heat Transfer. Part I." New York, The American Society of Mechanical Engineers, 1961.

The thermal efficiency of a simple two-element thermoelectric generator was derived from the basic equation governing the flow of heat in the elements. The analysis was restricted to one-dimensional flow of heat and electric charge. The temperature dependence of the pertinent property values, thermal conductivity, electrical resistivity, and Thomson coefficient, was completely arbitrary. A simple equation was obtained for the efficiency. Numerical results are presented for a doped lead telluride generator operating between 1100 and 100°F. The thermal efficiency was obtained with a maximum error of 3%. The efficiency of this generator was also calculated by the "average figure of merit" method and by the "average property value" method. The results of these averaging methods are 10% higher and 3% lower, respectively, than the new method. The new equation is an exact solution for the optimum efficiency when the Thomson coefficient is zero and the thermal conductivity and electrical resistivity have arbitrary temperature dependence. (auth)

13225 AN EXACT METHOD FOR DETERMINING THE THEORETICAL PERFORMANCE OF A THERMOELECTRIC GENERATOR WHEN MATERIAL PROPERTIES ARE ARBITRARY FUNCTIONS OF TEMPERATURE. Douglas L. Kerr (General Electric Co., Philadelphia). p.93-103 of "International Developments in Heat Transfer. Part I." New York, The American Society of Mechanical Engineers, 1961.

A practical, exact procedure for determining the performance of thermoelectric generators when material properties are arbitrary functions of temperature is presented. Comparison of results using this procedure with those of an approximate procedure for a particular set of materials and operating conditions indicated that the approximate procedure will give very good results in many cases. This method should therefore find considerable use only in detailed design work and as a means of checking the accuracy of approximate procedures whenever work on new materials is begun operating conditions considerably different are used. (auth)

13226 THE HEAT TRANSFER AND FLOW FRICTION CHARACTERISTICS OF FIVE OFFSET RECTANGULAR AND SIX PLAIN TRIANGULAR PLATE-FIN HEAT TRANSFER SURFACES. D. C. Briggs (Garrett Corp., Los Angeles) and A. L. London. p.122-34 of "International Developments in Heat Transfer. Part I." New York, The American Society of Mechanical Engineers, 1961.

Basic heat transfer and flow friction design data are presented for eleven different configurations of highly compact plate-fin surfaces. Five surfaces are of the offset rectangular-fin type and six are of the plain triangular-fin type. Some cores were constructed of aluminum and others involved a combination of stainless steel and nickel construction suitable for high temperature applications. One surface had an area compactness exceeding 1300 ft^2 of surface/ft^3 of volume between plates. It was the most compact surface tested, and it was of stainless steel construction suited to high temperature service. (auth)

13227 HEAT TRANSFER DURING EVAPORATION OF HIGH QUALITY WATER–STEAM MIXTURES FLOWING IN HORIZONTAL TUBES. C. Rounthwaite and M. Clouston (Head Wrightson and Co., Ltd., Thornaby-on-Tees, Eng.). p.200-11 of "International Developments in Heat Transfer. Part I." New York, The American Society of Mechanical Engineers, 1961.

A high-pressure steam rig was built to study the evaporation of wet steam in a horizontal hair-pin type of tube, 1.6 in. bore, for a wide variety of flow rates, steam pressure, and quality conditions, but at relatively low heat-fluxes. The internal heat transfer coefficients were measured during the transition from high "boiling" values to low superheated values, which occurs at high steam qualities. Under all test-conditions the fall in coefficient was fairly rapid, and generally occurred at steam qualities between 94 and 98%. The value of the coefficient before "transition" showed a direct dependence on flow-rate, though under some conditions the onset of transition was very much affected by heat flux. Local coefficient measurements made around the circumference of the tube showed that at low steam velocities a stratified flow condition existed at inlet to the test-section. Furthermore, under all test conditions the actual transition did not occur in a uniform manner around the tube-section. The fall in coefficient first occurred at the top of the tube-section and then gradually spread around the sides to the bottom. This phenomenon was qualitatively explained with reference to possible water-steam flow patterns in the tube during transition. (auth)

13228 HEAT TRANSFER IN FILM BOILING TO SUBCOOLED LIQUIDS. F. Tachibana (Tokyo Univ.) and S. Fukui. p.219-23 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

The cooling rate of quenching depends upon the heat transfer by both film and nucleate boiling to a subcooled liquid. The rate of heat transfer in film boiling to the subcooled liquid was calculated theoretically considering that the boundary layer of the liquid exists outside the vapor film. As a result of the tests on electrically heated nichrome wire in distilled water, alcohol, and carbon tetrachloride, a marked effect of the degree of subcooling on the heat transfer rate in film boiling was found. The experimental results agreed fairly well with the calculated results. (auth)

13229 BOILING HEAT TRANSFER FROM A FLAT SURFACE FACING DOWNWARD. Seikan Ishigai (Osaka Univ.), Kiyoshi Inoue, Zyumei Kiwaki, and Toshiki Inai. p.224-9 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

Pool boiling from a downward facing surface was experimentally studied by heating the top of a copper rod whose bottom end was immersed in water and served as the heating surface. The curve obtained by plotting the heat flux against the temperature difference was in many ways similar to the curve for the boiling from electrically heated wires. The behavior of the fluid on the heating surface was observed and photographed. Up to the burnout limit, the heating surface did not entirely dry out in spite of the presence of steam blanket because at least a part of the surface was intermittently swept by water when the steam blanket left the heating surface to escape into the atmosphere. After the burnout limit was reached, the heating surface was completely dried in spite of the violent motion of the bubbles emerging from the persisting steam blanket. (auth)

13230 THE HYDRODYNAMIC CRISIS IN POOL BOILING OF SATURATED AND SUBCOOLED LIQUIDS. Novak Zuber (General Electric Co., Schenectady, N. Y.), Myron Tribus, and J. W. Westwater. p.230-6 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

An analysis of the critical heat flux in pool boiling is presented. The similarity between nucleate boiling and the process of gas bubbling from a porous surface is discussed. The similarity indicated that the critical heat flux corresponds to the hydrodynamic phenomenon known as "flooding." The problem was formulated by considering the combined effects of Taylor and Helmholtz instabilities on the flow of the two-phase mixture. An analytical expression was derived which permitted the prediction of the critical heat flux from a horizontal surface (facing upward) in pool boiling of liquids at saturation temperature or subcooled. The theoretical results are in good agreement with available experimental data. (auth)

13231 BOILING CRISIS IN TUBES. I. T. Alad'ev (Aladyev) (Inst. of Energetics, Academy of Sciences, Moscow), Z. Z. Miropolskii (Miropolsky), V. E. Doroshchuk, and M. A. Styrikovich. p.237-43 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

Experimental data were obtained for critical heat fluxes in stainless-steel tubes heated by low-voltage current. The effects of heat flux distribution around the channel perimeter and along its length, the geometrical dimensions of the channel heated, and the compressibility of the medium in the section preceding the experimental one were determined. The flow was of subcooled water and steam–water mixtures. The critical heat flux increased with increasing velocity and subcooling at all pressures. (M.C.G.)

13232 TRANSIENT POOL BOILING OF WATER AT ATMOSPHERIC PRESSURE. H. A. Johnson, V. E. Schrock, F. B. Selph, J. H. Leinhard, and Z. R. Rosztoczy (Univ. of California, Berkeley). p.244-54 of "International Develop-

ments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

Experimental values of surface temperature and the volume of vapor produced are given for the atmospheric pool boiling of water on metal ribbons in which energy is uniformly generated at an exponentially increasing rate. The subcooling of the pool was varied between 2 and 112°F and the period of the transient pulse ranged between 5 and 80 milliseconds. These conditions are typical of those in a nuclear reactor experiencing a prompt-critical excursion. The results exhibited decided trends. They were reproducible only within broad limits, however, since the system is extremely sensitive to minor random variations. No general correlations were formed, but a method for predicting the rate of vapor volume development was devised and applied with some success in the case of saturated transient boiling. (auth)

13233 BURNOUT HEAT FLUXES IN POOL BOILING AT HIGH ACCELERATIONS. C. P. Costello and J. M. Adams (Univ. of Washington, Seattle). p.255-61 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

For a 0.134 inch outer diameter cylindrical heater with acceleration directed normal to its axis, the peak heat flux attainable in nucleate pool boiling increased slightly with acceleration up to $\alpha/g = 10$. For higher values of α/g the data behave according to the following equation: $q''_b \alpha(\alpha/g)^{0.25}$. This is the result predicted semi-analytically for heaters with accelerations directed normally away from the surfaces. It is postulated that a size effect exists and that for cylindrical heaters of larger diameters higher values of α/g are required to attain the result indicated by this equation. Some experimental verification of this postulate was obtained. The shape and slope of the boiling curve of q'' versus ΔT_{sat} for $\alpha/g = 1$ persisted up to burnout at least for α/g less than or equal to 44. The effect of acceleration on ΔT_{sat} was extremely small right up to the burnout heat flux. Wide variations in ΔT_{sat} did not appear to effect appreciably the heat flux at which vapor could stabilize on a heater surface. (auth)

13234 BURNOUT IN CROSSED-ROD MATRICES UNDER FORCED CONVECTION FLOW OF WATER. Stothe P. Kezios (Illinois Inst. of Tech., Chicago), Tong-Soo Kim, and Frank M. Rafchiek. p.262-9 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

The burnout of crossed-rod matrices was experimentally determined under conditions of varying water flow and degree of subcooling. The matrices placed under test were constructed by employing rows of equally spaced parallel rods (uniform transverse pitch) with the axes of the rods forming every third row offset by one-half the transverse pitch. Transverse pitches of 1.5, 2.0, and 3.0 were employed while the longitudinal pitch was held at unity for all matrices. Each matrix was twelve rows deep and an electrically heated element (solid rod) was located in the ninth row. The basic elements forming the matrices were $\frac{1}{8}$ in. diameter rods. Water-flow through the rod bundles was varied in the range of 175 to 575 $lb_m\ sec^{-1}ft^{-2}$, corresponding to a face velocity in the range of about 2.8 to 9.3 ft/sec, while the degree of subcooling was varied between 70 and 180°F. The results showed the burnout heat flux q''_{bo} to increase with decreasing transverse pitch. A general correlation was obtained for q''_{bo} as a function of mass velocity, degree of subcooling and transverse pitch. Comparisons of the results with those from the single-wire burnout study of Kezios and Lo showed the test rods in the matrix arrays withstand a higher burnout heat flux at any given mass velocity and degree of subcooling, in the range where such comparison is valid. (auth)

13235 AN EXPERIMENTAL INVESTIGATION OF OVER-ALL HEAT TRANSFER COEFFICIENTS FOR CONDENSING AND BOILING HYDROGEN FILMS. K. D. Timmerhaus (Univ. of Colorado, Boulder and National Bureau of Standards, Boulder, Colo.), D. E. Drayer, and J. W. Dean. p.270-8 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

Over-all heat transfer coefficients for condensing and boiling hydrogen films were determined for temperature gradients ranging from 0.38 to 6.06°F for a single smooth vertical brass tube. Temperature difference between the condensing and boiling films was regulated and observed by changes in vapor pressure. Over-all heat transfer coefficients under these experimental conditions were plotted not only as a function of the temperature difference but also of the heat flux and were compared as far as possible with known values in the literature and with computations based on the conventional design equations available in the standard texts. The latter comparison indicated that the computational values may in certain cases be off by as much as a factor of two to three. Consequently further investigations are being conducted to evaluate the over-all heat transfer coefficients and to check previously reported individual heat transfer coefficients especially with regards to the effect of surface conditions on these coefficients. (auth)

13236 SOME HYDRODYNAMIC ASPECTS TO TWO-PHASE FLOW AND BOILING. G. B. Wallis (United Kingdom Atomic Energy Authority, Winfrith Heath, Dorset, Eng.). p.319-40 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

By measuring void fraction, relative velocity, and agglomeration rate for the rise of air bubbles through various solutions, it was possible to rationalize variations in experimental results already available in the two-phase flow literature. The results were found to lie between theoretical predictions for two ideal flow regimes, "bubbly" and "slug" flow, which assume no bubble agglomeration in the former case and complete agglomeration in the latter. The characteristics of these ideal flow regimes were investigated experimentally as well as the process of transition between flow patterns. The results are applicable to the prediction of two-phase flow pattern, voidage, and pressure drop in systems in which the effects of wall shear stress are negligible. They are also of considerable importance for the understanding of the hydrodynamics of pool boiling. (auth)

13237 TWO-PHASE (STEAM AND WATER) FLOW AND HEAT TRANSFER. Mario Silvestri (C.I.S.E., Milan). p.341-53 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

Flow dynamics and heat transfer in steam-water systems were studied. Critical (or burnout) heat fluxes were determined for different conditions of heat input. The burnout heat flux showed a maximum, whose value depended on flow rate and quality, in addition to geometry and pressure. The maximum was reached when the inlet mixture linear velocity had a definite value, which was strongly dependent only on pressure. (M.C.G.)

13238 HEAT TRANSFER TO HIGH PRESSURE SUPERHEATED STEAM IN AN ANNULUS. J. G. Collier

and P. M. C. Lacey (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.354-62 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

Equipment is described for measuring the heat transfer characteristics of steam or steam-water mixtures flowing in annuli, at pressures up to 1500 psi. Point heat transfer coefficients are presented for single phase superheated steam at pressures from 20 to 1075 psi. The curve of log $Nu/Pr^{1/3}$ vs log Re was steeper than 0.8, particularly in the low Reynolds number (low pressure) runs but tended to approach the traditional Colburn relationship at high Reynolds number (1.3 to 3.2×10^5). With a calming section 18.2 diameters long the entrance effect could be correlated equally well by a factor $(L/D_e)^{-0.1}$ or a factor of the form $(1 + mD_e/L)$, with appropriate coefficients. (auth)

13239 TWO-PHASE PRESSURE GRADIENT. W. L. Owens, Jr. (Univ. of Aberdeen, Scotland). p.363-8 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

A method of calculating two-phase pressure drop is presented that is not limited to any specific flow problem or substance. The derivation of an expression for the pressure gradient was made with the assumptions of homogeneous flow and that the two-phase friction factor is the same as for single-phase liquid flow. An experimental verification was made of the derived equations. (M.C.G.)

13240 HEAT TRANSFER INVESTIGATIONS FOR THE FLOW OF STEAM RANGING UP TO SONIC VELOCITY. A. W. Scott and R. M. G. Meek (Royal Coll. of Science and Tech., Glasgow). p.369-77 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

An investigation was made of heat transfer in the flow of superheated steam through a duct. The effects of frictional heating were studied. The heat transfer was determined at the inner surface of an annular duct through which the superheated steam was expanded, reaching sonic velocity at the outlet. The variation of recovery factor and heat transfer along the test length enabled the nature of the boundary layer to be determined. A comparison was made of heat transfer coefficients for high- and low-velocity flow in ducts. (M.C.G.)

13241 THE HEAT TRANSFER AND FRICTION CHARACTERISTICS FOR FORCED CONVECTION AIR FLOW OVER A PARTICULAR TYPE OF ROUGH SURFACE. F. J. Edwards and N. Sheriff (United Kingdom Atomic Energy Authority, Capenhurst, Ches., Eng.). p.415-25 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

The effect on the local heat transfer coefficient of transverse wires fixed to a flat heating surface was measured for a two-dimensional turbulent air flow. The wires were of circular cross-section and were attached to the surface at right angles to the fluid flow. A single wire became fully effective in improving the heat transfer locally when its diameter was approximately equal to the combined thicknesses of the laminar sub-layer and the buffer layer. Increasing the diameter further produced little improvement locally, but the distance over which the effect was experienced increased fairly uniformly with wire diameter. Using a wire size representative of those which were fully effective in the single wire tests, local heat transfer coefficients were measured between multiple wires at various pitches. Pressure drop tests were made at various Reynolds numbers for pitches of 16 wire diameters and above. The test results were compared with those predicted by some of the more recent investigators. (auth)

13242 HEAT TRANSFER TO A TURBULENT STREAM FROM A SURFACE WITH A STEP-WISE DISCONTINUITY IN WALL TEMPERATURE. D. B. Spalding (Imperial Coll. of Science and Tech., London). p.439-46 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

A general method is provided for the prediction of local heat transfer rates through a turbulent boundary layer at points on a wall downstream of a sudden discontinuity in wall temperature. The stream velocity need not be uniform, and the surface may be either axi-symmetrical or two-dimensional, but the temperature differences must be small enough not to affect the fluid properties. Approximate and exact results are presented for the case Pr = 1. The predictions of the theory are shown to accord with those of earlier authors in the ranges where the latter are valid, but to be of wider validity. Comparison with experiment is also satisfactory, but insufficient experimental data are available on local heat transfer coefficients immediately downstream of the wall discontinuity. Work on non-unity values of Prandtl number is still required. A single analytical formula which describes the velocity distribution throughout the whole of a "universal" turbulent boundary layer is given. (auth)

13243 TURBULENT TRANSFER FROM ISOTHERMAL SPANWISE STRIPS ON A FLAT PLATE. H. H. Sogin (Tulane Univ., New Orleans) and R. J. Goldstein. p.447-53 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

The sublimation from a flat plate with various hydrodynamic starting lengths was studied experimentally. The problem is essentially the same as that for heat transfer from a flat plate with a step in the wall temperature. Attempts were made to correlate the data on the basis of a product of the analog of the so-called isothermal coefficient and a step function factor. The experimental results were favorably correlated by certain combinations of isothermal coefficient and step function factor and not by others. Under the extension of the analogy by Deissler and Loeffler, the data fell in fair agreement with the Seban step function factor. The Kármán formulation appeared to yield a correlation between the Seban and the Rubesin step function factors, in fair agreement with the Ferrari step function for m = 6.17, derived from the velocity profile measurements. A good correlation was obtained by combining the Colburn analogy with the Rubesin step function factor. Any of the above combinations of isothermal coefficients and step function factors could be used successfully for predicting Stanton numbers in the range of the experiments for Sc = 2.5. It appeared that the most successful correlation for isothermal heat transfer data over a large range of Prandtl numbers was obtained with an analysis similar to the one by Deissler and Loeffler. This would give preference to the Seban step function factor. (auth)

13244 USE OF THERMODYNAMIC SIMILARITY IN GENERALIZING EXPERIMENTAL DATA OF HEAT TRANSFER. V. M. Borishanskii (Borishansky) (Boiler-Turbine Inst., Leningrad), I. I. Novikov, and S. S. Kutateladze. p.475-82 of "International Developments in Heat Transfer. Part II." New York, The American Society of Mechanical Engineers, 1961.

For a full similarity of thermal transfer process in various liquid flows it is essential that these liquids should be thermodynamically similar and should have equal values

of similarity criteria characterising the conditions on the liquid-solid interface. The comparison of experimental data should be made for correlated states. The usual comparison, without considering thermodynamic similarity should be regarded as approximate. The theory of thermodynamic similarity shows that the relation of any physical property of substance to the state parameter can be presented as an arbitrary dimensional multiplier composed of the principal molecular characteristics of the substance: the mass of the molecule m/g, the critical parameters R_k, V_k, T_k, and the gas constant R, by the universal function of reduced parameters π, ϕ, τ and the relation C_{V_0}/R. The availability of these general relations eliminates difficulties in deducing similarity laws from basic equations of motion and the boundary conditions and enables similarity criteria to be established for the case of variable physical properties of liquid. Thus instead of the actual physical properties of the liquid, for instance, the viscosity or thermal conductivity coefficients, the similarity criteria will incorporate dimensional multipliers of the general functional relation for the above properties. On the basis of the thermodynamic similarity theory additional conditions of similarity of heat transfer processes can also be established. (auth)

13245 HEAT TRANSFER TO MERCURY IN PARALLEL FLOW THROUGH BUNDLES OF CIRCULAR RODS. Aaron J. Friedland (Atomic Power Development Associates, Detroit), Orrington E. Dwyer, Michael W. Meresca, and Charles F. Bonilla. p.526-34 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961. (BNL-5111)

Studies were made of heat transfer to mercury for the case of turbulent, parallel flow through staggered rod bundles. A study of the entrance effect indicated that fully established flow conditions were achieved at about 35 equivalent diameters from the inlet end, for all flow rates. At a given axial point in the test bank, a relatively large circumferential variation in the surface temperature of the heater was generally observed. Interchanging each heater with its opposite number resulted in a 120° displacement of the variation. There was a tendency for the data from different tubes to show the greatest variation at lower Peclet numbers and to converge at higher Peclet numbers. (M.C.G.)

13246 MEASUREMENTS OF HEAT-TRANSFER COEFFICIENTS, FRICTION FACTORS, AND VELOCITY PROFILES FOR AIR FLOWING PARALLEL TO CLOSELY SPACED RODS. Luther D. Palmer and Leonard L. Swanson (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.535-42 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961. (GA-1787)

The design of gas-cooled reactors with solid-rod fuel elements is predicated on knowledge of the pressure-drop and heat-transfer characteristics within the reactor core. Heat-transfer and fluid-dynamic studies were made with air flowing parallel to the rods of a seven-rod cluster. The parallel rods were equally spaced in a triangular array with a 1.015 ratio of center-to-center distance to rod diameter, the rod surfaces forming flow passages of tricuspid-shaped cross section. Average and local heat-transfer film coefficients, pressure drops, and velocity profiles were measured under established hydrodynamic conditions. The measured average heat-transfer film coefficients were approximately equal to those for smooth round ducts; however, the peripheral variation of the local coefficients at a Reynolds number of 20,000 was 0.5 to 1.3 of the average values. Fanning friction factors calculated from static-pressure-drop measurements made along the length of a flow passage were approximately 5% higher than those for smooth round ducts over a Reynolds number range of 3000 to 30,000. The velocity structure in the flowing gas was determined at a Reynolds number of 20,000. The peripheral variation of the ratio of local to bulk mean velocity was found to be very nearly equal to the ratio of the local to average heat-transfer coefficient. This agreement of the local and average heat-transfer data is to be expected from the analogy between fluid friction and heat transfer. (auth)

13247 IMPROVEMENT OF FUEL ELEMENT HEAT TRANSFER BY USE OF ROUGHENED SURFACES AND THE APPLICATION TO A 7-ROD CLUSTER. A. Draycott and K. R. Lawther (Australian Atomic Energy Commission, Sutherland, New South Wales). p.543-52 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

Heat transfer and fluid flow characteristics of 21 roughened surfaces were measured in an atmospheric air rig. A method was developed which selects the better surfaces for future development. Surfaces with Whitworth threads, chamfered square ribs, or modifications of these, appeared to offer the best prospects. No general correlation was found for all surfaces. There was a fairly general deviation from the linear in Reynolds number relationships with both friction factor and Stanton number at Reynolds numbers greater than 3×10^5. Some results could be better correlated using a function of Reynolds number multiplied by the square of Mach number. Fluid friction characteristics of a 7-rod were assembled with different spacings and surfaces measured. Some correlation of these results was obtained and the better arrangements selected. (auth)

13248 HEAT TRANSFER WITH AXIAL FLOW IN ROD CLUSTERS. H. W. Hoffman, J. L. Wantland, and W. J. Stelzman (Oak Ridge National Lab., Tenn.). p.553-60 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

Temperature and heat-transfer distributions were determined as a function of axial and circumferential position on the surface of a cluster of seven rods arranged in a hexagonal pattern within a channel of circular cross section and cooled by air flowing longitudinally along the rod surfaces. Circumferential temperature variations of the order of ±10% around the mean were observed with minima occurring in regions of close approach to adjacent tubes or the channel wall. The amplitude of these variations was found to be significantly less than that predicted by the theoretical analysis of Deissler and Taylor; a circumferential displacement of the profile maxima and minima from the anticipated locations was also noted. The influence of a mid-cluster spacer was such as to effect thermal entrance conditions over most of the cluster length. At the exit end of the cluster, the heat-transfer coefficient approached an asymptotic value of 26 Btu/hr · ft² · F. Measurements on mass removal from naphthalene-coated rods were applied, through the analogy relations, to the determination of heat transfer in rod-cluster geometries. For a geometry identical to that used in the heat-transfer studies, it was found that circumferential profiles of the j-factor showed a greater variation around the mean for the mass-transfer data than for the heat-transfer data. At the same time a comparison of the mean j-factors showed only a 10% disparity ($j_M = 0.0034$, $j_H = 0.0031$). The circumferential patterns in the mass-transfer profiles were qualitatively related to heat-transfer coefficient distributions on single rods oriented trans-

versely to the flow; the presence of cross flow in the rod cluster was implied. A further study by the mass-transfer technique into the effect of rod spacing on the circumferential heat-transfer distributions showed least variation in the profile and maximum mean j-factor for the situation in which the surface of the peripheral tubes was equidistant from the channel wall and the surface of the central tube. (auth)

13249 HEAT TRANSFER TO SUPERCRITICAL WATER AT 5000 PSI FLOWING AT HIGH MASS FLOW RATES THROUGH ROUND TUBES. Kurt Goldmann (Nuclear Development Corp. of America, White Plains, N. Y.). p.561-8 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

Experimental and predicted heat transfer data for 5000 psi water, flowing at high mass flow rates through round tubes, are presented and compared. Differences between predictions and experiments at high temperatures are indicative of how the heat transfer data may be used to obtain better values for conductivity and viscosity than those based on extrapolations of presently available property measurements. A "boiling"-like mechanism is postulated as a model for heat transfer under high heat fluxes and low bulk temperatures for supercritical fluids. The model is used to explain observations of an unusual mode of heat transfer. (auth)

13250 AN INVESTIGATION OF HEAT TRANSFER TO FLUIDS FLOWING IN PIPES UNDER SUPERCRITICAL CONDITIONS. B. S. Petukhov, E. A. Krasnoschekov, and V. S. Protopopov (Power Engineering Inst., Moscow). p.569-78 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

The results of experimental investigations revealed that local heat transfer in the supercritical region of parameters of state, at small wall-to-fluid bulk temperature differences, with good approximations, is correlated by well-known equations valid at constant physical properties. When the temperature differences are large the heat transfer rate depends essentially on the character of the transverse variation of specific heat, thermal conductivity and viscosity. A correlation of the available experimental data on heat transfer to carbon dioxide and water in the supercritical region is proposed. In the case of small variations of the fluid physical properties, this equation modifies to an equation, valid at constant physical properties. Thus the correlation is valid in the supercritical region as well as in regions remote from the critical state. (auth)

13251 COMPUTED REFERENCE TEMPERATURES FOR TURBULENT VARIABLE-PROPERTY HEAT TRANSFER IN A TUBE FOR SEVERAL COMMON GASES. Robert G. Deissler and Alden F. Presler (Lewis Research Center, Cleveland). p.579-84 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

Turbulent forced-convection heat transfer in a tube with large temperature differences between the wall and the fluid was analyzed for several gases. The calculations were carried out using the best available properties for several gases. The gases considered are air, helium, argon, hydrogen, and carbon dioxide in the wall temperature range from 2000 to 6000 R. The results are presented as reference temperatures for evaluating the properties in the Nusselt, Reynolds, and Prandtl numbers. The utility of these reference temperatures lies in the fact that they allow constant-property results to be used for variable properties. (auth)

13252 TURBULENT HEAT TRANSFER IN THE CRITICAL REGION. L. B. Koppel (California Inst. of Tech., Pasadena) and J. M. Smith. p.585-90 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

Heat transfer coefficients were measured for carbon dioxide, at and near its critical point, in turbulent flow in a heated cylindrical tube. When the bulk temperature of the fluid entering the tube is below the transposed critical temperature (temperature corresponding to maximum specific heat), unusual axial variations in the heat transfer coefficient occur. The coefficient could be either larger or smaller than the expected result depending upon the heat flux, wall temperature, and flow rate. The pertinent properties showed extreme changes with temperature in this region. This made it difficult to decide whether property changes or another mode of transport, such as a boiling-like phenomenon, is the cause of the unusual results. (auth)

13253 SIMULTANEOUS DEVELOPMENTS OF TEMPERATURE AND VELOCITY PROFILES IN FLAT DUCTS. Lit S. Han (Ohio State Univ., Columbus). p.591-7 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

Heat transfer in tubes of finite length with both temperature and velocity profiles developing was investigated and an integral method developed for solving the problem. The method of constructing the temperature function is outlined. The application of the procedure to a problem involving a pair of parallel plates is shown. (M.C.G.)

13254 METHOD OF CONFORMAL MAPPING IN FORCED CONVECTION PROBLEMS. L. N. Tao (Illinois Inst. of Tech., Chicago). p.598-606 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

The forced convection problems of a fully developed flow in ducts with linearly varying axial wall temperature and arbitrary heat generation were approached by the method of conformal mapping. With an appropriate conformal representation, the cross section of a duct in the physical plane is mapped onto a unit circle in the transformed plane. The sought solutions in terms of some analytic functions are then directly obtainable from the mapping function. The determinations of these analytic functions are established. Examples of an indented pipe of cardioid section and of a hexagonal duct were investigated. It was found that the error by using the usual approach of equivalent hydraulic diameter is not negligible. (auth)

13255 THE EFFECT OF A LONGITUDINALLY VARYING WALL HEAT FLUX ON THE HEAT TRANSFER COEFFICIENT FOR TURBULENT FLOW IN A PIPE. W. B. Hall and P. H. Price (Univ. of Manchester, Eng.). p.607-13 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

The experimental results of Stanton Number against X (distance along pipe from start of heating divided by diameter of pipe) for a uniform heat flux are in good agreement, both as regards magnitude and shape of curve, with the theoretical values given by Sparrow et al. The results for both the exponential and the sinusoidal heat flux distributions are in reasonable agreement with theoretical predictions derived from uniform heat flux measurements. The former distribution is of academic interest in that it leads to a constant Stanton Number as X increases, while the lat-

ter is of some practical interest in nuclear reactor cooling. While the consequences of ignoring the effects of heat flux distribution shape are not likely to be large in present designs of reactor, they may become important in smaller reactors having a lower length to diameter ratio for the cooling channels. Finally, it is suggested that the technique of predicting heat transfer coefficients for an arbitrary heat flux distribution from measurements for the case of uniform heat flux, may find some application in reducing experimental results to a common basis for comparison. For example, it is possible to estimate the effect of a short unheated section, such as may result from electrical connections to heaters, on the heat transfer downstream. (auth)

13256 TRANSIENT HEAT TRANSFER IN A CONVECTION COOLED HETEROGENEOUS NUCLEAR REACTOR WITH AXIAL POWER DENSITY. W. O. Doggett and R. H. Schultz, Jr. (North Carolina State Coll., Raleigh). p.622-33 "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

Theoretical temperature distributions were obtained for the fuel and coolant regions of a reflected heterogeneous, convection cooled nuclear reactor with axial power variation $P_0e^{wt} \sin (\pi/H)(z + d)$. Distributions for general reactor time variation were obtainable by superposing the analytic solutions given. Fundamental assumptions in the governing differential equations are that local heat transfer from the fuel region to the bulk coolant can be adequately represented by a constant heat transfer coefficient, and that the temperature distribution in the fuel region does not vary in the direction transverse to coolant flow. The solutions contain two- and three-parameter integrals which are expressed in terms of tabulated one-parameter functions suitable for analytic parameterization studies and desk calculator computations. Typical distributions are presented. Asymptotic forms for long times, small reciprocal periods w, small or large fuel to coolant heat capacity ratios, or a bare core (d = 0) are given and compared with previously published solutions. Points of maximum fuel and coolant temperatures and their time dependence were obtained from the asymptotic expressions. This work is an extension of an earlier treatment for the unreflected reactor. (auth)

13257 THE EFFECT OF A RIGHT-ANGELED BEND ON HEAT TRANSFER IN A PIPE. A. J. Ede (National Engineering Lab., East Kilbride, Glasgow). p.634-42 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

The local heat transfer coefficient in a pipe conveying water was measured in the region immediately downstream of four different right-angled bends, having the following ratios of bend radius to pipe radius: 21/1, 8/1, 4/1, and mitred elbow. The tests covered a range of Reynolds numbers from 500 to 50,000. Results are presented in graph form. With few exceptions, the local heat transfer coefficient had abnormally high values after a bend. With turbulent flow the effect was small, and its magnitude was not significantly affected by the heat flux rate nor by upstream conditions. With laminar flow the effect was large, and markedly affected by the upstream temperature distribution. The distribution of heat transfer coefficient around the periphery of the pipe was also studied. (M.C.G.)

13258 THE EFFECTS OF ONSET OF TAYLOR VORTICES ON HEAT TRANSFER. F. C. Haas and A. H. Nissan (Rensselaer Polytechnic Inst., Troy, N. Y.). p.643-51 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

The qualitative and quantitative aspects of stability of a fluid in isothermal circular motion are discussed briefly. The presence of a small non-isothermal state is shown to have no effect upon the fluid mechanics of the system. Heat transfer to three liquids in circular motion between horizontal concentric cylinders is considered experimentally and a correlation of these results and literature results for air is given. (auth)

13259 TURBULENT HEAT TRANSFER IN PSEUDOPLASTIC NON-NEWTONIAN FLUIDS. R. M. Clapp (Cambridge Univ., Eng.). p.652-61 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

Velocity distribution equations for a power law pseudoplastic fluid in turbulent flow, based on a three zone flow model, were derived and the constants and limits of these equations determined experimentally. Close correlation of the measured friction factors was obtained by an equation derived by integration of the proposed velocity distribution equation for the turbulent core over the pipe diameter. Martinelli's analogy between heat and momentum transfer was extended to turbulent flow of a pseudoplastic fluid and the experimentally determined temperature distributions were closely correlated by the theoretical expressions for the turbulent core and the buffer layer, but in the laminar sublayer the observed temperature differences were less than those predicted, the differences being greatly reduced by evaluation of the fluid properties at the wall temperature in this region. The observed heat transfer coefficients were correlated by a modified form of the Dittus-Boelter equation and a further modification of this equation, in which the Reynolds number is a function of the index of viscosity of the fluid, is proposed. (auth)

13260 THE RATIO OF THE EDDY DIFFUSIVITIES FOR HEAT AND MOMENTUM AND ITS EFFECT ON LIQUID METAL HEAT TRANSFER COEFFICIENTS. Tokuro Mizushina and Tadahisa Sasano (Kyoto Univ.). p.662-8 of "International Developments in Heat Transfer. Part III." New York, The American Society of Mechanical Engineers, 1961.

The ratio of eddy diffusivities for heat and momentum for liquid metals was predicted by a modified mixing length theory. There was fairly good agreement between the experimental and theoretical results. Using these ratio of eddy diffusivities, Martinelli's theory was modified and corrected for contact resistance. The predicted curves of heat transfer coefficients appeared to give a good representation of the experimental data. (auth)

13261 TRANSIENT HEATING AT AN AXISYMMETRIC STAGNATION POINT WITH MASS ADDITION. William P. Manos and Donald E. Taylor (Univ. of Chicago). p.731-6 of "International Developments in Heat Transfer. Part IV." New York, The American Society of Mechanical Engineers, 1961.

Experiments were performed to demonstrate the effectiveness of mass transfer cooling at axisymmetric stagnation points. The models employed in these experiments were subjected to transient heating in the plasma discharge of a one-megawatt, high-intensity, air-stabilized electric arc. To interpret the experimental results, the equations governing transient heating of a porous medium with a steady rate of mass flow were derived, and a closed form solution was obtained. This solution was applicable to one-dimensional heat flow in a medium subjected to a constant heat flux rate at one surface with incompressible mass flow

from a constant temperature reservoir at the opposite surface. The solution involved the basic assumption that the temperatures of the porous matrix and the flowing fluid are identical at corresponding locations. (auth)

13262 AN EXPERIMENTAL INVESTIGATION OF THE LOCAL PACKING AND HEAT TRANSFER PROCESSES IN PACKED BEDS OF HOMOGENEOUS SPHERES. J. Wadsworth (National Research Council, Ottawa). p.760-9 of "International Developments in Heat Transfer. Part IV." New York, The American Society of Mechanical Engineers, 1961.

The local packing configurations that occur in a randomly stacked bed of homogeneous spheres were examined, both as a function of position in the bed and the size of container. It was concluded that only incomplete rhombohedral packing configuration exists when smooth, hard homogeneous spheres are randomly stacked into smooth, hard containers, and the distribution of the incompleteness is random throughout the bed. Preliminary instrumentation of a sphere enabled the local heat transfer to be investigated on the surface area of an isolated sphere over a range of Reynolds number from 20,000 to 240,000. Examination of the local flow conditions enabled differences between this work and that of extant literature to be explained. This work on the isolated sphere proved the suitability of the instrumentation for measuring local heat transfer. Experimentation was carried out measuring the distribution of the local heat transfer over the surface area of a sphere when immersed in rhombohedral array. A range of Reynolds numbers of from 8000 to 60,000 was covered. These heat transfer results are presented on a stereographic net. (auth)

13263 THE MEASUREMENT OF HEAT-TRANSFER COEFFICIENTS IN PACKED BEDS BY THE CYCLIC METHOD. R. M. G. Meek (National Engineering Lab., East Kilbride, Glasgow). p.770-80 of "International Developments in Heat Transfer. Part IV." New York, The American Society of Mechanical Engineers, 1961.

An apparatus was developed by which the measurement of the heat transfer coefficient by the cyclic method may be carried out for the flow of air through packed beds or porous solids. Measurements were obtained for several matrices consisting of randomly packed beds of steel balls. The velocity of approach varied from 120 to 500 cm/sec, and the frequency of temperature variation was from 0.16 to 80 cycles/min. Heat-transfer results were calculated from measurements of the ratio of upstream to downstream temperature amplitude. Both heat transfer and friction factors were plotted against Reynolds number. Values of the heat transfer coefficient obtained for those matrices in which the wall effect was eliminated were found to be greater than those based on average measurements over the whole cross section for matrices where no measures were taken to eliminate the wall effect. Equations were solved for the case of cyclic heat exchange in a bed of spheres taking into account the finite conduction of heat into the solid. A set of theoretical curves was obtained showing the relationship between the temperature amplitude ratio and the other variables for various heat transfer coefficients. (M.C.G.)

13264 PERFORMANCE OF THERMAL REGENERATORS UNDER SINUSOIDAL FLOW CONDITIONS. PART I. J. A. Murray (United Kingdom Atomic Energy Authority, Winfrith Heath, Eng.) and B. W. Martin. p.781-8 of "International Developments in Heat Transfer. Part IV." New York, The American Society of Mechanical Engineers, 1961.

Experiments indicated that the heat transfer in square mesh screen matrices is affected by operation under approximately sinusoidal flow. But over the ranges tested, only where the porosity of the matrix was high was there an appreciable response of the heat transfer to a change in frequency. It is suggested that otherwise the heat transfer is related to wave shape rather than to frequency. Under sinusoidal flow, the thermal ratio of the screen matrices investigated fell below that obtained for the same Reynolds number in steady flow by an amount which depended on the utilization factor. Heat transfer measurements were best correlated with those of steady flow by the method proposed by Tong. His correlation may therefore be used to estimate the performance of this type of regenerator matrix when used in "Stirling" type engines. (auth)

13265 PERFORMANCE OF THERMAL REGENERATORS UNDER SINUSOIDAL FLOW CONDITIONS. PART II. F. J. Bayley (Kings Coll., Newcastle upon Tyne, Eng.) and C. W. Rapley. p.789-95 of "International Developments in Heat Transfer. Part IV." New York, The American Society of Mechanical Engineers, 1961.

Data were established for the heat transfer performance of flame trap and gauze matrices in thermal regenerators in steady fluid streams. The data from the gauze matrices indicated heat transfer coefficients which were appreciably greater than obtained by many previous workers, but were in excellent agreement with the experiments of Kays and London. The results from the flame trap matrices compared very well with those of previous workers, although the predominating effects of longitudinal heat conduction appeared to vitiate the results at very low rates of flow. The effects of a time-variant rate of flow were found to be quite different in the two types of matrix. In those of flame trap construction the unsteady flow had little adverse effect upon the thermal performance of the regenerator, and, indeed, at the higher rates of flow, where the effects of axial conduction were least, the apparent rates of heat transfer were increased compared with those applying in the steady air stream. The gauze matrices, however, showed a clear decrease in effectiveness when operated at other than the highest thermal ratios in an unsteady air stream. This result was explained by applying classical regenerator theory to the conditions of the experiments in the so-called quasi-steady manner. In this it was assumed that the instantaneous performance of the regenerator corresponds to the instantaneous values of the independent variables, reduced length and reduced time. The resulting variations in temperature are shown to correspond to an appreciable reduction in the thermal performance of the regenerator. The results suggest that gauze matrices, at least from the point of view of fundamental heat transfer performance, are less suitable for applications of the regenerator in which cyclic variations in flow are likely to occur. Such is the situation in the Stirling Air Engine, the development of which created the need for this work, in which it would appear that the long, continuous passages of the flame trap type of regenerator matrix would be more effective. However, compactness is an important requirement of a matrix for this practical application, and the ease which very large areas of heat transfer surface can be accommodated in small volumes by the use of fine gauzes suggests that these will always have an important place in regenerator design. The thermal design of the gauze matrices must, however, take account of the time-variant effects. (auth)

13266 HEAT TRANSFER IN A THERMAL RADIATION ABSORBING AND SCATTERING MEDIUM. R. Viskanta (Argonne National Lab., Ill.) and R. J. Grosh. p.820-8 of "International Developments in Heat Transfer. Part IV."

New York, The American Society of Mechanical Engineers, 1961.

Heat transfer in a thermal radiation absorbing, emitting, and scattering medium is considered. The basic equation of radiant heat transfer, the equation of transfer which describes the radiation field in an isotropic medium, is discussed, and the mathematical analogy between transfer of thermal radiation and neutron transfer is pointed out. Consideration is then given to a one-dimensional system consisting of two diffuse, nonblack, isothermal, parallel plates, separated by a finite distance. The formulation of the integral equation for the incident radiation, the equation for net emission, and the equation for the radiant heat flux were derived. The non-homogeneous Milne's integral equation governing the temperature distribution in the medium was solved. Numerical results are given in graphical form as functions of the optical thickness of the medium. (auth)

13267 TESTS ON A ROTATING TUBE HEAT EXCHANGER HAVING CONTROLLED FLUID FLOW. R. F. Pattenden (Royal Military Coll. of Science, Shrivenham, Wilts, Eng.) and A. D. Richards. p.903-11 of "International Developments in Heat Transfer. Part V." New York, The American Society of Mechanical Engineers, 1961.

Experiments were carried out on a heat exchanger which consisted of concentric annuli separated by a smooth tube which could be rotated about its axis. From the core of the inner annulus, radial vanes projected toward the rotating tube without actually touching it. Similarly, there were vanes mounted on the outer wall of the outer annulus. Hot water was passed along the inner annulus, cold water along the outer, in contra-flow. Over-all heat transfer coefficients were measured over a range of rotating tube speeds. Results are given in the form of graphs of overall heat transfer coefficients against rotor speed. Controlling the flow direction in the outer annulus had no appreciable effect on the performance of the heat exchanger. Changing the cold water flow rate did not affect the performance. The hot water flow rate had an appreciable effect. The sensitivity of the heat transfer coefficient to the degree of control exercised over the flow direction in the inner annulus, contrasted with the absence of such an effect in the outer annulus, is discussed. (M.C.G.)

13268 LOCAL SHELL-SIDE HEAT-TRANSFER COEFFICIENTS IN A LEAK-PROOF HEAT-EXCHANGER. J. W. Stachiewicz and B. Short (McGill Univ., Montreal). p.959-66 of "International Developments in Heat Transfer. Part V." New York, The American Society of Mechanical Engineers, 1961.

Local heat transfer coefficients were measured on the shell-side of a leak-proof two-dimensional model heat exchanger. Experimental results indicated that heat transfer coefficients in the baffle-window-zone can be correlated by the same type of equation as that used for the cross-flow zone. The Reynolds Number exponent 'a' in the heat transfer equation $J_H = C\ N_{Re}^{a}$ is identical for both zones, provided that window mass-velocities are based on a geometric mean of window- and cross-flow areas. The constant C in the equation $J_H = C\ N_{Re}^{a}$ appears to be somewhat lower in the window zone than in the cross-flow zone. Experimental evidence is needed to verify if introduction of leakage through baffle holes and around baffles in a cylindrical exchanger will alter this disparity significantly. If not, the use of identical equation in calculation of heat transfer coefficients in the two zones might lead to unsafe predictions. (auth)

13269 COMPUTATION OF NATURAL CONVECTION BY FINITE DIFFERENCE METHODS. J. D. Hellums and S. W. Churchill (Univ. of Michigan, Ann Arbor). p.985-94 of "International Developments in Heat Transfer. Part V." New York, The American Society of Mechanical Engineers, 1961.

Explicit, finite difference equations were devised which permit the direct computation of the transient and/or steady state velocity and temperature fields for natural convection from the partial differential equations describing the conservation of mass, momentum, and energy. Exploratory calculations on an IBM 704 computer yielded results in agreement with existing steady state solutions and experimental data. The method does not require the idealizations necessary to obtain analytical solutions and is applicable to many problems in fluid mechanics and heat transfer. (auth)

13270 NATURAL CONVECTION IN A LIQUID CONTAINING A DISTRIBUTED HEAT SOURCE. D. Wilkie and S. A. Fisher (United Kingdom Atomic Energy Authority, Seascale, Cumb., Eng.). p.995-1002 of "International Developments in Heat Transfer. Part V." New York, The American Society of Mechanical Engineers, 1961.

The theory of Woodrow successfully predicted the form that the temperature profiles will take in natural convection in a liquid containing a distributed heat source in long cells. At low heat generation rates the temperature differences were approximately correct in the cylindrical cell but the central velocities were much lower than predicted in both cells. Sinuosities and eddies existed that are not predicted by the simple theory, but it may be that the experiments were done in a transitional regime. The vertical temperature gradient was not controlled in a simple way the the coolant flow. (auth)

13271 FREE CONVECTIVE HEAT TRANSFER TO A SUPERCRITICAL FLUID. C. A. Fritsch and R. J. Grosh (Purdue Univ., Lafayette, Ind.). p.1010-16 of "International Developments in Heat Transfer. Part V." New York, The American Society of Mechanical Engineers, 1961.

Laminar free convection from a vertical, isothermal plate was studied for water close to the critical point where there are marked variations in density and specific heat. The basic equations, reduced by use of a similarity transformation, were numerically integrated on a digital computer. The results were appreciably different from those predicted by a constant properties analysis. (auth)

13272 ON COMBINED FREE AND FORCED CONVECTIVE LAMINAR MAGNETOHYDRODYNAMIC FLOW AND HEAT TRANSFER IN CHANNELS WITH TRANSVERSE MAGNETIC FIELD. Yasuo Mori (Cornell Univ., Ithaca, N. Y.). p.1031-7 of "International Developments in Heat Transfer. Part V." New York, The American Society of Mechanical Engineers, 1961.

The problem of fully developed, combined free and forced convective, laminar, magnetohydrodynamic flow and heat transfer in vertical channels with transverse magnetic field was studied. The effects of the magnetic field on the flow and temperature patterns are discussed. When M denotes Hartmann number and Ra Rayleigh number, this problem is found to be divided into three cases. The first one is that for $M^4 < 4\ Ra$, where the magnetic field is shown to flatten the velocity profiles. The second case considers the flow when $M^4 > 4\ Ra > 0$, which has the Hartmann flow as its limit. It is also shown that between these two cases there exists a very narrow region where the ratio of the mean velocity to that without the magnetic field has a weak singularity. The third case is for $Ra < 0$. This includes the problem of dependence of the flow direc-

tion on Rayleigh number, and it is shown that the magnetic field resists the reversal of the flow direction and increases the Rayleigh number required for flow reversal. (auth)

Instrumentation

Refer also to abstracts 13432, 13439, 13440, 13442, 13443, 13445, 13446, 13449, 13450, 13451, 13452, 13453, 13454, 13455, 13456, 13457, 13458, 13459, 13460, 13461, 13462, 13463, 13464, 13465, 13466, 13467, 13468, 13469, 13470, 13471, 13472, 13473, 13474, 13475, 13476, 13482, 13483, 13484, 13754, 13755, 13756, 13757, 13758, 13759, 13760, 13763, 13765, 13818, 13920, 13921, 14065, 14066, 14067, 14069, 14070, 14071, 14079, 14082, 14083, 14084, 14085, 14086, 14087, 14088, 14089, 14090, 14091, 14093, and 14094.

13273 (AERE-EL/M-97) AN INVESTIGATION OF THE POSSIBILITY OF USING A NEUTRON SOURCE TO MEASURE THE SPECIFIC GRAVITIES OF STEAM-WATER MIXTURES IN A THICK PIPE. J. A. Dennis (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1957. 24p.

It is shown that neutron methods for measuring the specific gravities of steam–water mixtures in a 1 inch bore steel pipe, give about the same relative change in counting rate for a given change in specific gravity as would a method using gamma rays, and that the gamma method is preferable for thicknesses of pipe wall up to one inch. The reasons for this preference are the low cost of equipment and the higher counting rate that can be obtained with the gamma method for a given source activity. (auth)

13274 (AERE-M-693) TRANSISTOR HT CONVERTER—A HIGHLY STABLE DC REGULATED SUPPLY. E. P. Fowler (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1960. 11p.

A stable d-c regulated supply using a converter to generate high voltages from low voltage is described. The drift in the amplifier, which limits the output stability, is reduced to ~3 parts/million/°C. (D.L.C.)

13275 (AF-SAM-62-23) THE USE OF POWDERED ALANINE AS A SOLID DOSIMETER. W. W. Bradshaw and D. G. Cadena, Jr. (Southwest Research Inst., San Antonio) and G. W. Crawford and H. A. W. Spetzler (School of Aerospace Medicine, Brooks AFB, Tex.). Aug. 9, 1961. 7p.

Powdered dl-alanine was fabricated to form solid state dosimeters. The irradiated powder has been found to be stable with no measurable change in the number of free radicals created 14 days after irradiation and only a 5% decay 90 days after irradiation. Plastic and glass specimen holders for the ESR unit were used as part of a search for a holder giving the best signal-to-noise ratio. Preliminary experimental results with an accuracy of ±5% have been obtained for gamma irradiated dosimeters between 100 to 100,000 r, beta irradiated dosimeters between 100 to 20,000 rads, proton irradiated dosimeters between 250 2000 rads, and x-ray irradiated dosimeters between 1000 to 20,000 r. The data have been plotted as the relative ESR intensity in arbitrary units versus dose for the various radiations. (auth)

13276 (CEA-2073) NOUVEAU COMPTEUR A SCINTILLATION A TRES FAIBLE TEMPS DE RESOLUTION. (A New Scintillation Counter with Very Fast Resolving Time). Lydie Koch (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 8p.

The rare gases used as scintillators are characterized by their short luminescent time and by the linearity of their response as a function of the total energy imparted to the gas by the incident particle. It is possible with these scintillators, when associated with a fast-response photomultiplier, to build a linear detector with a very fast resolving time (a few nsec). Two examples of the construction of this type of apparatus are described. (tr-auth)

13277 (DC-57-8-150) CALIBRATION OF RHENIUM–MOLYBDENUM AND RHENIUM–TUNGSTEN THERMOCOUPLES TO 3200°F. John C. Lachman (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 21, 1957. Contract [AT(11-1)-171]. 16p.

Calibration curves for rhenium–molybdenum and rhenium–tungsten thermocouples are presented for temperature measurements to 3200°F. Practical applications are discussed as well as advantages and limitations of these elements. (auth)

13278 (DC-57-10-63) CALCULATION OF NaI CRYSTAL EFFICIENCY. J. W. Ryan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 7, 1957. Contract AT(11-1)-171. 46p.

A 650 digital program is presented to perform calculations of absorption efficiency of NaI crystals varying three parameters, the radius of the crystal, the distance from the source, and the absorption cross section of the gamma ray. A total of 378 variations are evaluated. The program employs the ANP floating point routine. The machine time for one evaluation is approximately one minute and twenty-five seconds. (auth)

13279 (DC 58-1-5) GEPU PULSE PREAMPLIFIER MODEL-C. G. K. Rusch (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 27, 1957. Contract AT(11-1)171. 14p.

A pulse preamplifier is described which utilizes peaking circuits to maximize its gain and a pulse transformer to match the output impedance of the preamplifier to a coaxial cable. Stability and other performance characteristics are shown. (auth)

13280 (DC-58-1-162) VOLTAGE CONTROLLED VARIABLE FREQUENCY WAVEFORM GENERATOR. E. W. Fortner (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 21, 1958. Contract AT(11-1)-171. 7p.

An instrument which furnishes a pulse output is described. The pulse repetition rate is controlled by, and is proportional to, an applied input voltage. The output pulse repetition rate is variable from 10 cycles sec^{-1} to 10^4 cycles sec^{-1}. (auth)

13281 (DC-58-8-715) THE MODIFICATION OF BLACK AND WHITE COMMERCIAL CLOSED CIRCUIT TELEVISION CHAINS TO PROVIDE A STEREO PRESENTATION. J. T. Meyer (General Electric Co. Aircraft Nuclear Propulsion Dept., Idaho Falls, Idaho). Aug. 15, 1958. Contract [AT(11-1)-171]. 18p.

Fabrication of a prototype system to combine two black and white closed circuit television chains for production of a black and white stereo presentation is described. (J.R.D.)

13282 (DC-58-9-26) A HIGH IMPEDANCE INPUT CIRCUIT USING GERMANIUM TRANSISTORS. J. J. Baum (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 2, 1958. Contract [AT(11-1)-171]. 17p.

A boot strapped emitter follower circuit, which achieves an input impedance greater than 10^7 ohms using Ge transistors is described. The circuit is analyzed and compared with a single emitter follower and a super alpha connected emitter follower for input impedance characteristics. (auth)

13283 (DC-58-9-34) PULSE PREAMPLIFIER REPORT–PROJECT 102. Charles N. Jackson, Jr. and James C. Volt (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 2, 1958. Contract AT(11-1)-171. 27p.

Information on maintenance, test procedure, performance data, and application data for the pulse preamplifier used in Project 102 nuclear startup system is presented. (auth)

13284 (DC 59-1-23) DESIGN AND TESTING OF A SHIM SERVO AMPLIFIER. J. A. Showalter (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 2, 1959. Contract AT(11-1)-171. 17p.

A Shim Servo Amplifier was designed which when properly connected to the output of an existing sensor and a remotely located control unit would move shim rods at a velocity proportional to the flux error to regulate reactor power. The unit met a large number of requirements yet was simple in construction, rugged, and light in weight. The theory of operation, design, and operational characteristics of this servo amplifier are discussed. (auth)

13285 (DC 59-1-63) NUCLEAR HEATING RATE SENSORS. G. K. Rusch and S. N. Stilwell (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 3, 1959. Contract AT(11-1)-171. 11p.

Sensors were built to measure the nuclear heating rate in proposed moderator and control rod materials. The design deficiencies are discussed and recommendations proposed for future heating rate sensor designs. Details of materials including slug weights and thermocouple positions are given in DC 58-12-9. (auth)

13286 (DC-59-2-153) A MAGNETIC AMPLIFIER VOLTAGE INTEGRATOR. Phillip C. Sharr (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 9, 1959. Contract AT(11-1)-171. 7p.

A magnetic amplifier voltage integrator is described that has 10:1 or 0.1:1 gain adjustment without changing values of the input resistance or the values of capacitors. General and limiting performance of this integrator is indicated. (auth)

13287 (DRCL-343) A PORTABLE GAMMA SURVEY METER USING AN UNSATURATED ION CHAMBER. P. C. East (Canada. Defence Research Chemical Labs., Ottawa). Feb. 1961. 26p.

The saturation curve in ionization chambers is examined, with particular attention to the unsaturated region, in which only a fraction of the total number of ions produced is collected. By operating in this region the ion current can be made to vary approximately as the logarithm of the intensity of the ionizing radiation. The design and performance of a survey meter that covers the range 0.5 to 500 r/hr on a single scale and operates over the temperature range from 125 to −65°F with its batteries in situ are described. The variation in chamber current with temperature, inherent in an unsaturated chamber, is partially compensated for by the negative temperature coefficient of the load resistor. The unsaturated ion chamber with a cathode follower electrometer amplifier provides a very stable instrument. (auth)

13288 (HASL-119) PREPARATION OF ETCHED CIRCUITS FOR LABORATORY USE. Frederick C. Wilson (New York Operations Office. Health and Safety Lab., AEC). Jan. 1962. 30p.

A method for producing etched circuits in small quantities is described. These circuits are constructed relatively quickly, and are inexpensive, less prone to error, and easier to repair than those produced by other methods. (J.R.D.)

13289 (HW-71388) A SENSITIVE FLOWMETER FOR MEASURING VERTICAL WELL FLOWS. J. D. McCormack (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1961. Contract AT(45-1)-1350. 18p.

A remotely operated flowmeter to measure vertical water flow in wells was developed and tested. Flow up or down the well is blocked by inflating a sealing element or packer. The flow is channeled through an orifice in a flexible diaphragm. The resulting displacement of the diaphragm when water flows is sensed by a linear variable differential transformer whose armature is linked to the diaphragm. The range of the instrument is 30 to 600 cc/min (4.4 to 88 feet per day), and the sensitivity is ±30 cc/min in an eight-inch well. The meter was used to log 22 project wells and has given satisfactory service. Definite flows were found in 12 wells, usually in the downward direction. (auth)

13290 (IDO-16741) SPERT III THERMOWELL FAILURE AND REPLACEMENT. R. E. Heffner, S. W. Gleave, and J. A. Norberg (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 2, 1962. Contract AT(10-1)-205. 15p.

In January 1961, an immersion section of a primary coolant system thermowell was found in the bottom of the Spert III reactor vessel. Subsequent evaluation of the failure and the methods to verify the design adequacy of all primary system thermowells are presented. (auth)

13291 (IFA-M-26) IDEAL POLE FOR WEAK- AND STRONG-FOCUSING NUCLEAR INSTRUMENTS. C. C. Iliescu (Academia R. P. R. Institutul de Fizica Atomica, Bucharest). [Nov. 20, 1961]. 13p.

General expressions for describing ideal pole faces (i.e., pole faces for which the median plane of the instrument has a constant field index) are studied, and various formulas having practical applications in the shaping of pole faces are reviewed. Both weak- and strong-focusing instruments are considered. (T.F.H.)

13292 (NAA-SR-Memo-6283) CONTROL UNIT FOR AUTOMATIC NORMALIZATION OF FOIL COUNTING. L. S. Beller (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 14, 1961. Contract AT(11-1)-Gen-8. 21p.

A control instrument for use in an automatically normalized counting system is described. In response to command signals from a preset scaler, the control instrument provides the preset scaler with a clock signal or a counting signal representing the activity of a monitor foil. This procedure makes optimum use of the available activity. The instrument provides two internal sources of clock signals, and can be used for fixed-interval counting. Details of the design, construction, and adjustment are given. (auth)

13293 (NAMC-ASL-1050(Pt.I)) DEVELOPMENT OF RESISTANCE STRAIN GAGES USABLE UP TO 1600°F. Period Covered, June 21, 1955 to June 21, 1956. G. Steven and J. P. Sheehan (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 23, 1962. Contract N156S-32317. 36p.

Developmental work on a quasi-static high temperature strain gage to measure large strains in the temperature range 1000 to 1600°F is reported. Refractory single phase alloys with Fe, Co, and Ni bases were selected for exploration as strain gage wires. Besides good oxidation resistance it was aimed to achieve a low temperature coefficient of resistance and matching expansivity with the chosen base material. The solid solution alloys of the Fe-Cr-Al composition approached most closely the ideal requirements for high temperature strain gage wires. Several alloys in this group were vacuum melted and the hot and cold forming properties were determined. Fe-25 Cr-5 Al, Fe-25 Cr-7.5 Al, and Fe-20 Cr-10 Al alloys ultimately were drawn into 0.001 in./0.002 in. diameter wires. Strain gages fabricated from these wires were cemented to Inconel test bars and preliminary gage calibrations were made at elevated temperatures. (auth)

13294 (NIRL/R/9) AN ACCURATE DETERMINATION OF THE P.L.A. BEAM ENERGY BY A TIME OF FLIGHT METHOD. C. J. Batty and D. J. Warner (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England). July 1961. 23p.

An accurate time-of-flight method for measuring proton energies was developed and used to determine the output proton energy of the proton linear accelerator operating at 30 Mev. A detailed analysis showed that the precision obtainable (±0.16%) compares favorably with other available methods in the 10 Mev to 50 Mev region. (auth)

13295 (NP-11418) RESEARCH TO PRODUCE A TEMPERATURE STABLE MATERIAL WITH A HIGH THERMOELECTRIC FIGURE OF MERIT. Report No. 8 (Final) [on] THERMOELECTRIC MATERIALS AND DEVICE RESEARCH. B. Gossick, J. Morrison, L. Stubbe, and H. Whitehurst (Arizona State Univ., Tempe). Jan. 15, 1962. Contract DA-36-039 SC-85249. 46p.

The properties of a semiconducting solid sol were studied, since the dispersed particles might scatter phonons and at the same time contribute electrical current carriers to yield a large thermoelectric figure of merit. It was decided to study rutile (TiO_2) because of its stability at high temperatures and its large dielectric constant. The polycrystalline ceramic form of rutile was studied because of its relative lack of dependence of electrical properties on the presence of grain boundaries. The proper choice of dispersed phase hinged upon the type of electrical contact between the material of the dispersed phase and the semiconducting medium. In the course of investigating the electrical contacts between various substances and rutile, some rectifiers were made that showed promise for practical applications. The current-voltage characteristics and the transient response of these rectifying barriers were discussed. The method of preparing ceramic rutile and the fabrication process for forming barriers on the surface were also treated. (auth)

13296 (PAN-248/XIII) TUSHENIE LYUMINESTSENTSII ZnS VSLEDSTVIE OBLUCHENIYA V ATOMNOM REAKTORE. (Quenching ZnS Luminescence by Irradiation in a Nuclear Reactor). A. Wrzesinska and P. Jaszczyn (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 11p.

The effects of reactor irradiation on ZnS phosphors prepared at different temperatures were examined. The steady luminescence, and the glow and growth curves were measured. It appeared that the reactor irradiation diminishes the luminescence intensity at elevated temperatures and increases the infrared quenching. The time of luminescence growth became longer. On the other hand, neutron-bombarded ZnS phosphors stored less light than the unirradiated ones. These results showed that the lattice defects created by the fast neutron bombardment fulfilled the functions of hole traps. An empirical coefficient D was introduced. (auth)

13297 (PAN-265/XIII) "TEKSTOLIT" IONIZATION CHAMBER FOR GAMMA-EMITTERS ACTIVITY MEASUREMENTS. J. Jablonska and K. Jablonski (Polish Academy of Sciences, Inst. of Nuclear Research, Warsaw). July 1961. 10p.

Information is given on the construction, characteristics and calibration of the small cylindrical ionization chamber with the walls made out of "tekstolit" (high-pressure laminate from cotton tissue with phenol-formaldahyde resin). This chamber is connected with a d-c amplifier and is used for the measurements of activity of Ir^{192}, Co^{60} and Au^{198} sources of great activity (above 100 mc). The chamber calibration results are presented and the measurements errors are discussed. (auth)

13298 (PPAD-433C) ORBIT CALCULATIONS FOR THE 15" BUBBLE CHAMBER. Technical Report No. 27. Kenneth Edwards (Princeton–Pennsylvania Accelerator, Princeton, N. J.). Oct. 4, 1961. Contracts AT(30-1)-2137 and Nonr-1858(06). 19p.

A program for computing orbits of charged particles in cylindrically magnetic fields is described. (J.R.D.)

13299 (SCTM-137-61(24)) GATED NANOSECOND PULSE SHAPER. Robert D. Moyer (Sandia Corp., Albuquerque, N. Mex.). May 1961. Contract [AT(29-1)-789]. 21p.

A pulse shaper based on the recovery transient of a junction diode is described. The prototype is operative at 15 to 300 Mc and pulse widths are 8 nanoseconds at 15 Mc repetition rate, 4 nanoseconds at midband, and 1.4 nanoseconds at 300 Mc. The amplitude varies from 2.5 volts at the end points to 5 volts midband. (J.R.D.)

13300 (TID-14178) GAMMA-SCATTERING DENSITY METERS: ANALYSIS AND DESIGN WITH APPLICATIONS TO COAL AND SOIL. R. A. Semmler, J. E. Brugger, and F. F. Rieke (Chicago. Univ. Labs. for Applied Sciences). Dec. 1961. Contract AT(11-1)-712. 126p. (LAS-TR-161-35)

Gamma-scattering density gages using uncollimated sources and detectors were examined to determine sources of error and the influence of design parameters such as gamma source energy, source-detector separation, and geometric configuration. The sensitivity to chemical composition and to variations in the charge-to-mass ratio was examined and was found to be potentially significant but can be controlled by eliminating response to photons with energy less than 100 to 200 Kev. An optimum threshold is shown to exist in some cases. The experimentally determined gage response is expressed in the form $R \propto (\mu r)^n e^{-\mu r}/r^2$ with n = 1.6 and is compared with the calculated response utilizing buildup factors based on spectra calculated by the moments method. A gage with a positive-slope calibration curve rather than the usual negative slope is shown to be practical and requires only a small fraction of the radioactivity usually employed. Applications in the measurement of coal density and the conversion of pulse height distributions obtained with a scintillation crystal to photon distributions are discussed. (auth)

13301 (TID-15226) A COMPREHENSIVE SURVEY OF SEVERAL ASPECTS IN THE DESIGN OF A HIGH ENERGY TOTAL ABSORPTION CERENKOV RADIATION COUNTER (thesis). Robert J. Kolouch (Tufts Univ., Medford, Mass.). Aug. 1960. 69p.

A comprehensive survey of several aspects in the design of a 6-Bev total absorption Cherenkov radiation counter was effected. The size of the radiating block necessary to contain, on the average, a very large percentage of a cascade shower initiated by an electron or photon was estimated. The results are presented graphically and include transition curves of the number of electrons in lead for 800, 1200, 1600, and 6000 Mev incident photons, and integral track length curves for 6000, 2000, and 750 Mev incident electrons. Theoretical calculations involving resolution of the counter were obtained from a consideration of the number of photoelectrons and the statistical standard deviation in the number of photoelectrons produced at the photocathode of a typical photomultiplier tube. For a 2 Bev incident electron the photon production in Cherenkov light was found to yield a 1.41% resolution, if the entire light output could be collected at the tubes. In a more realistic case, a reasonable estimate of a 10% light collection efficiency yielded a 4.5% resolution for the 2-Bev electron. (auth)

13302 (TID-15279) DEVELOPMENT OF SMALL IN VIVO β-RAY DETECTORS AND THEIR DIAGNOSTIC APPLICATIONS. Progress Report. Charles V. Robinson (New England Center Hospital, Boston). Mar. 12, 1962. Contract AT(30-1)-1726. 8p.

Development of beta detectors for use in brain tumor localization with P^{32}, diagnosis of eye tumors with P^{32}, and intracardiac detection of shunts with Kr^{85} is discussed. For brain-tumor localization, a 2-mm-diameter, tip-sensitive, proportional probing counter was developed. For diagnosis of eye tumors, a flat detector with a 5-mm-diameter sensitive area was developed. Two curved counters were also constructed. Two of the short 2-mm counters were used for intracardiac detection of shunts. (M.C.G.)

13303 (UCRL-6740) TECHNIQUES FOR EVALUATING THE COMMERCIAL PHOTOCATHODE. George A. Condas (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 12, 1962. Contract W-7405-Eng-48. 37p.

Techniques and theory for determining the steady-light, non-time-dependent properties of the commercial photocathode are given. These properties are explained and descriptions of the equipment necessary to measure them are also given. An exact tungsten color temperature of 2870°K was found unnecessary for a correct determination (error ±5%) of the tungsten-light-source cathode sensitivity. But this color temperature was found necessary for an accurate determination of the more important blue-light cathode sensitivity. A photocathode's quantum efficiency when used with a UBL plastic scintillator (number of photoelectrons per fluor photon) was also calculated. (auth)

13304 (UCRL-10009) AN INTEGRAL DESIGN TECHNIQUE FOR WIDEBAND MULTISTAGE TRANSISTOR AMPLIFIERS. Larry Scott (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 14, 1961. Contract W-7405-eng-48. 28p.

A philosophy for designing wideband multistage transistor amplifiers is presented. The amplifier was visualized as an integral unit, the interstage networks constituting the elements of the amplifier unit. By designing the amplifier as a unit and adjusting the over-all response (gain and bandwidth) with the interstage time constants, an increase in gain-bandwidth product was realized over the iteratively designed amplifiers. The resulting increase in gain-bandwidth product resulted from absence of the bandwidth shrinkage factor for multistage amplifiers. Formulas were derived for both a two- and three-transistor integrally designed wideband amplifier, in which shunt peaking networks were used for coupling. Experimental amplifiers were constructed following these formulas, and the observed performance agreed quite well with the calculations. (auth)

13305 (USNRDL-TR-543) THE EFFECT OF COLLIMATION ON THE RESOLUTION AND PEAK-TO-TOTAL RATIO OF A NaI(T1) CRYSTAL. F. M. Tomnovec and P. A. Read (Naval Radiological Defense Lab., San Francisco). Jan. 31, 1962. 20p.

Restriction of the incident radiation to a small area of a NaI(T1) scintillation crystal improves the resolution and peak-to-total ratio of the spectrometer. This effect is studied with a series of tapered lead collimators, all with the same apex but with differing apertures, in front of a 4-in. by 4-in.-diameter NaI(T1) scintillation crystal. Sources of gamma rays with energies from 0.28 to 2.76 Mev are located at the apex of the taper. Optimum resolution of about 25 percent greater than broad-beam resolution is obtained with a 0.25-in. diameter aperture. Anomalous effects are observed with a smaller opening. (auth)

13306 (AEC-tr-4546) NUCLEAR ELECTRONICS: PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON NUCLEAR ELECTRONICS ORGANIZED BY THE FRENCH SOCIETY OF RADIOELECTRICIANS, PARIS, 1958. Translation of French papers from "L'Electronique Nucleaire: Comptes Rendus du Colloque International sur l'Electronique Nucleaire Organise par la Societe Francaise des Radioelectriciens, Paris, 1958." (A Publication of the International Atomic Energy Agency, Vienna, 1959). 519p.

Originally issued in two volumes as STI-Pub. No. 2).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract numbers 5400 and 5448.

13307 (AEC-tr-5062) TEMPERATURE DEPENDENCE OF SCINTILLATION COUNTERS. H. Schneider and H. Wassel. Translated by Walter H. Weber and William L. Briscoe (Los Alamos Scientific Lab., N. Mex.) from Atomkernenergie, 6: 98-100(1961). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 18288.

13308 (FTD-TT-61-442) PLASMA FREQUENCY-CONTROL OF A TRAVELING-WAVE-TUBE TYPE OSCILLATOR. V. D. Ivanova and V. S. Mikhalevskii (Mikhalevskiy). Translated from Radiotekh. i Elektron., 6: 1888-93(1961). 10p.

Frequency control of a traveling-wave-tube type oscillator into which a plasma tube was inserted by varying the natural frequency of the plasma is studied. The characteristic impedances and dispersion characteristics for unbounded plasma, and the dispersion characteristics taking into account the plasma tube thickness are calculated. Theoretical and experimental results are compared. (J.R.D.)

13309 (JPRS-12487) ON THE APPLICATION OF GAMMA RADIATION BARRIERS TO CHARGE-LEVEL CONTROL MEASUREMENTS IN LIQUID-CHLORINE VESSELS. Kurt Thormann. Translated from Automatisierung, 4: No. 7, 298(July 1961). 4p.

A probe consisting of a Co^{60} source is inserted into the tank of liquid Cl_2. When the liquid level reaches the height of the source, the counting rate at a nearby detector is diminished, and visual and auditory signals are activated. The method can measure the liquid level to 1 cm, and can be used with liquid inflow rates on the order of 110 kg/hr. (T.F.H.)

13310 (NP-tr-841) A THEORETICAL INVESTIGATION OF CURVES GIVEN BY A GAMMA SPECTROGRAPH

WITH A SINGLE VARIABLE CHANNEL. J. C. Philippot. Translated by S. Pease (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Bull. inform. sci. et tech. (Paris), No. 45, 2-12(Nov. 1960). 29p. (Handwritten MS. copy).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 11216.

13311 (NP-tr-868) PROBLEMS AND RESULTS OF THE FILM DOSIMETRY OF IONISING RADIATIONS. K. Becker. Translated by R. I. R. Tantram (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Phot. Korr., 96: Nos. 6/7/8, 83-8; 99-104; 115-25(1960). 69p.

Developments in the use of photographic emulsions for dosimetry of ionizing radiations are reviewed. It is pointed out that film dosimetry is the best method for continuous radiation protection monitoring for civil and military purposes. Technical aspects of photographic film dosimetry are discussed in detail. (117 references) (C.H.)

13312 INVESTIGATION OF A SIEGBAHN- SLÄTIS BETA-RAY SPECTROMETER. Teuvo Kohonen, Heikki Puolakka, and Heikki Vaeyrynen (Inst. of Tech., Otaniemi, Finland). Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 89, 1-22(1962). (In English)

An intermediate image beta-ray spectrometer was studied theoretically by calculating the trajectories of electrons and optimizing the form of the magnetic field. The field along the axis is assumed to be of the form $H_0(z) = (H_2 - H_1)(z - D)^2/D^2 + H_1$. Calculations were performed with the aid of an Elliott 803 electronic computer. The results are compared with experiments performed on a small iron-jacketed spectrometer (the distance between the source and the detector was 600 mm). In this device a coil of new design was incorporated. The coils were made of 0.3×35 mm^2 copper strip lacquered together and cooled by forced air circulation. Rather good agreement between calculated and measured characteristic values was obtained. For example, with the source diameter and the central diaphragm width both set at 2mm, experimental 1.8 and 3.8% were found for the resolution and the transmission (with the F line of ThB). The calculated values were 2.0 and 3.0%, respectively. (auth)

13313 USE OF SEMICONDUCTOR SPECTROMETRIC COUNTERS FOR MEASURING THE ENERGY OF FISSION FRAGMENTS. N. M. Kazarinov, O. A. Matveev, S. M. Ryvkin, S. M. Solov'ev, N. B. Strokan, and D. V. Tarkhin (Inst. of Physics and Tech., Leningrad). Atomnaya Energ., 12: 153-4(Feb. 1962). (In Russian)

Surface-barrier type counters, prepared by vacuum-sputtering of Au on n-type Si, were used for determining the energy of fission fragments. The target, placed in a vacuum chamber with thin Al walls, consisted of a UF_4-coated Al disc and contained 92.8% enriched U^{235}. The Si counter was placed about 1.5 cm from the target in a collimated beam. The amplified pulses were recorded on a 100-channel analyzer. The spectra thus obtained differed from those derived from time-of-flight data. Further study indicated that design of the counter caused fission fragment energy losses in the surface layer which were larger than when the counter was used for studying α particles. On the basis of these results it was decided to reduce the surface area of the counter to 10 mm^2. The differences in the results may be due to losses within the fissioning material, to energy removal by neutron, and to ionization defects in the Si counter. As a general rule, Si counters yield more precise results in the field of the fission fragment energy measurements than ionization chambers. (TTT)

13314 CRYOTRON AS IONIZING-PARTICLE DETECTOR. N. K. Sherman (Queen's Univ., Kingston, Ont.). Can. J. Phys., 40: 372-6(Mar. 1962).

The cryotron is used as a detector of alpha particles or fission fragments. It has 2 gate loops of dissimilar metals, such as Sn and Pb, and is held at a temperature just below the lower of the two critical temperatures. It is kept in a metastable state with the Sn loop carrying a current slightly below the value at which superconductivity is destroyed. The passage of a heavily ionizing particle through the Sn loop destroys the superconductivity and causes the current to switch into the other loop, registering a count. (L.N.N.)

13315 SEMICONDUCTOR RADIATION DETECTORS DEMONSTRATE THEIR PRACTICALITY. Harold C. Hood. Electronics, 35: No. 11, 28-9(Mar. 16, 1962).

The basic principles and usefulness of the detectors are discussed. The detectors are sensitive to low-energy particles, hence they are useful in space measurements, probing oil well survey holes, determining neutron spectra as a function of position in reactors, and in many industrial process control instruments. Illustrations are given of the circuit diagram, operating principle, and linearity range of an epithermal neutron spectrometer using semiconductors. (N.W.R.)

13316 DESIGNING EQUIPMENT FOR NUCLEAR ENVIRONMENTS. P. Barratt (Pye Ltd., Cambridge, Eng.). Electronics, 35: No. 11, 51-7(Mar. 16, 1962).

The effects of radiation environments, characterized by high doses but comparatively low dose rates and rates of flux change, on electronic equipment are discussed and analyzed. Damage is illustrated with simple models of the structure of matter and the characteristics of each type of radiation. Damage to metals, dielectrics, semiconductors, and electronic components is summarized along with the activities of materials after irradiation. The threshold radiation required to produce displacements is given for different types of radiation. (N.W.R.)

13317 USING A VIBRATING CAPACITOR AS AN ELECTROMETER INPUT. V. J. Caldecourt (Dow Chemical Co., Midland, Mich.). Electronics, 35: No. 14, 48-50 (Apr. 6, 1962).

Instead of using a conventional chopper to convert a d-c input signal, a vibrating capacitor is used as the conversion element of an electrometer. The circuit diagram, vibrating capacitor mounting, and performance of the electrometer using the capacitor are described along with the method for optimizing the parameters of the vibrating capacitor and the associated circuit components. (N.W.R.)

13318 CADMIUM SULFIDE γ-RADIATION DETECTORS. N. G. Drozdov, N. I. Gorelov, B. S. Savashkevich, and A. I. Kukarin. Elektrichestvo, No. 1, 49-51(Jan. 1962).

Samples of CdS detectors with a high Co^{60} γ-radiation sensitivity were obtained by sublimating CdS powder on a heated conductive base layer which acted as one of the detector electrodes; the second electrode was deposited on a prepared layer of CdS by vacuum vapor deposition. The investigation of several samples gave the following results. A 1.5-cm^2 photosensitive layer 1 mm thick has an average sensitivity of 100 to 300 μamp/r/hr at a 10-v electrode voltage. Certain samples displayed a sensitivity of 500 to 700 μamp/r/hr. There was good linearity in the relationship of photocurrent to γ-radiation intensity (up to 500 r/hr). The detectors may be useful in dosimetry in cases where their slow response can be tolerated. The comparatively high sensitivity of CdS detectors also makes possible their use for direct recording of photocurrents and in relay circuits without additional amplification. CdS

detectors are recommended also as γ relays in automatic systems operating under the action of γ or x radiation (an x irradiation with 90 kev increases sample sensitivity to Co^{60} about 15 times). (OTS)

13319 TRANSISTORIZED PULSE LENGTHENER. P. F. Manfredi and A. Rimini (CESNEF, Milan). Energia nucleare (Milan), 9: 82-3(Feb. 1962). (In English)

A transistorized pulse lengthener in which the output voltage on the storage condenser is compared, through a long-tailed pair, with the input pulse is presented. The output current of this stage charges, through a diode, the storage condenser itself, so that the information on the peak value of the input pulse is obtained. (auth)

13320 AN APPARATUS FOR CONTINUOUS RECORDING OF NEUTRONS WITH SEMICONDUCTOR TRIODES. V. Kh. Leonov (Inst. of Earth Magnetics, Ionosphere, and Propagation of Radiowaves, Academy of Sciences, USSR). Geomagnetizm i Aeronomiya, 1: 444-5(1961). (In Russian)

A design is given of a neutron monitor operating with semiconductor triodes. The univibrator is erected on a 1115 triode. The minimum operation threshold 10 to 12 mv. (R.V.J.)

13321 ROLE PLAYED BY AMMONIUM SALTS IN THE CLEARING OF NUCLEAR EMULSIONS. O. N. Kaul (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys., 35: 562-7(Nov. 1961).

The effect of the addition of ammonium salts (ammonium chloride, ammonium sulfate, and ammonium acetate) to the usual hypo solution on the clearing time of nuclear emulsions and their influence on the grain size and the shrinkage factor, were investigated in view of previous contradictory results. The addition of the ammonium salts caused a decrease in the clearing time, and then a slight increase after attainment of the optimum concentration. The addition of ammonium salts, however, had no effect on the grain size or the shrinkage factor of nuclear emulsions. Results obtained were also explained on the basis of the current theory. (auth)

13322 ADVANCES IN HIGH POWER DISTRIBUTED AMPLIFIERS. D. A. Barge (Princeton Univ., N. J.). IRE Trans. on Nuclear Sci. NS-9, No. 2, 19-25(Apr. 1962). (PPAD-425-E)

Design criteria and practice of the high power distributed amplifier system for the Princeton-Pennsylvania Accelerator are discussed. The amplifier system employs a total of 166 Eimac 4CX300A tetrodes to achieve an average power gain of 5000. The system is designed to work over a range of frequencies of 2.5 to 30 Mc, but is capable of amplifying 60 Mc at a reduced duty cycle. The high level stages of the system limit the effective duty cycle to 25%, at the normal range of frequencies. (auth)

13323 A HIGH-VOLTAGE ELECTROLYTIC CAPACITOR BANK. Donald B. Hopkins and Pierre F. Pellissier (Univ. of California, Berkeley). IRE Trans. on Nuclear Sci. NS-9: No. 2, 68-73(Apr. 1962). (UCRL-9968)

A 5-kv electrolytic bank storing 150 kj has been in routine operation since 1958, and is currently being extended to 1 Mj. The bank is composed of 80 modular 12.5-kj sections, each module being a 12-by-12 series-parallel array of 1000-μf 450-v, standard electrolytic capacitors. Each module has its own charging, switching, and fault-sensing circuits. Including external voltage dividers and internal leakage current, about 24 w/kj is required to maintain the bank at full voltage. Normal one-quarter cycle discharge times are in the millisecond range with repetition rates ranging from one-half to 15 or more per minute, depending on the external circuit. Capacitor life, measured in years, is dependent upon the time required for the electrolyte to dry out, and is virtually unaffected by the operating schedule of the bank. Flexibility in the usage of the bank is ensured by having multiple output-switching ignitrons in each module. Sequencing and control circuitry provides for time-sharing of the bank by up to five users, each having independent control of bank capacity and voltage. (auth)

13324 THE SELECTION OF OPTIMUM TIME CONSTANTS FOR RC FILTERS WITH RANDOM SIGNALS. Roland A. Harvey (General Electric Co., Richland, Wash.). IRE Trans. on Nuclear Sci. NS-9, No. 2, 85-90(Apr. 1962). (HW-68607)

The application of statistics to the measurement of random signals, with particular emphasis on count-rate-meters, is considered. It is shown that under certain criteria, there are optimum values of time constants in the count-rate-meter circuit that will produce the desired results. While the emphasis is placed on the count-rate-meter, the same approach can be used to measure signals in the presence of noise where RC type smoothing is present. (auth)

13325 LIMITS OF RESOLUTION IN MAGNETICALLY FOCUSED IMAGE CONVERTER TUBES. G. Papp (ITT Federal Labs., Fort Wayne). IRE Trans. on Nuclear Sci. NS-9, No. 2, 91-3(Apr. 1962).

In a simple image tube in which the uniformly accelerated electrons are focused by a homogeneous magnetic field onto the phosphor, the error in focusing due to the arbitrary initial velocity of the photoelectrons is calculated. It is shown that optimum resolution can be obtained if focusing is adjusted for electrons leaving the cathode at the average initial forward velocity. A method to measure the initial average transverse velocity in the tube itself is developed. A practical formula for the expected resolution is derived for tubes with S-11 photocathodes and for the incident light coming from a slightly underheated incandescent lamp. (auth)

13326 RADIOMETRIC EQUIPMENT ON SECOND SPACESHIP-SATELLITE. S. F. Papkov, N. F. Pisarenko, I. A. Savenko, A. F. Tupikin, and P. I. Shavrin. (Academy of Sciences, USSR). Iskusst. Sputniki Zemli, No. 9, 78-85 (1961).

Equipment installed on the second Soviet spaceship-satellite to measure radiation and determine dose absorption is described. A scintillation counter recorded charged particles penetrating the skin of the spaceship and γ quanta with energies exceeding 25 kev. Two CTC-5 gas-discharge counters also recorded charged particles, and, as the efficiency of γ recording was low (below 10^{-2}), a comparison of readings made it possible to evaluate the contribution of the charged particles and the γ quanta, respectively, to the absorbed dose. A separate scintillation counter measured the energy flow of relatively soft charged particles. Electronic equipment was supplied with energy from a 6(± 1)-v battery with power not over 0.5 w. A thorough check of the spaceship after its return to earth demonstrated that all the counters and electronic devices had retained their efficiency. A block diagram of the equipment is given. (OTS)

13327 RADIOACTIVE LEVEL MEASURING AND CONTROL UNIT WITH PERIODIC OPERATION. Jiří Oppelt (Inst. for Research, Production and Application of Radioisotopes, Prague). Isotopentechnik, 1: 239-40(Nov. 1961). (In German)

A radioactive radiation barrier, which is suitable for the detection of small density variations, is described.

The instrument design is based on the conversion of an integrated ionization chamber charge into a voltage pulse. (tr-auth)

13328 AN IONIZATION CHAMBER APPARATUS FOR THE CONTINUOUS MEASUREMENT OF DENSITY VARIATIONS BY THE γ ABSORPTION METHOD. G. Brunner and G. Kunze (Institut für Angewandte Radioaktivität, Leipzig). Isotopentechnik, 1: 241-3(Nov. 1961). (In German)

After a brief discussion of density measurement methods using nuclear radiation attenuation by the usual methods, the operation and dimensions of a double ionization chamber for use in measuring liquid density are described. (tr-auth)

13329 DEVELOPMENT OF A WATER MONITORING DEVICE FOR A SPECIFIC ACTIVITY OF WATER BELOW 10^{-7} $\mu c/cm^3$. W. Ullmann (Institut für Staubforschung und Radioaktive Schwebstoffe, Berlin-Friedrichshagen). Isotopentechnik, 1: 248-50(Nov. 1961). (In German)

A water monitoring device, suitable for the determination of the specific activity of water below 10^{-7} $\mu c/cm^3$, was developed. It operates by using a novel spray evaporation method. (J.S.R.)

13330 DEPENDANCE OF POWER RADIATED ON BEAM CURRENT IN A MAGNETIC UNDULATOR. H. Motz and D. Walsh (Oxford Univ.). J. Appl. Phys., 33: 978-81(Mar. 1962).

It was found that with a particular 10-cm electron linear accelerator, power radiated from undulating electrons in the 8-mm band increased as $(\text{current})^{1.7}$. At higher frequencies there was only an approximately linear increase. A large undulator, designed to radiate in the fundamental mode at 8 mm, gave a half-watt power output. This output was in general agreement with the theoretical radiation from electrons combined with the experimental power law. (auth)

13331 CHARACTERISTICS OF A BORON-COATED PROPORTIONAL NEUTRON COUNTER IN THE CORONA ZONE. A. J. Tavendale (Univ. of Tasmania, Australia). J. Sci. Instr., 39: 124-6(Mar. 1962).

Characteristics are given for a boron-coated, argon-filled counter for thermal neutron detection which is operated proportionally in the corona zone. Application of short signal clipping times (2 μsec) and the use of high-valued anode load resistors ($\sim$100 megohms) result in counting plateaux extending 2 kv above corona threshold with mean slope less than 0.5% per 100 v. (auth)

13332 THE PERFORMANCE OF A GEIGER-MÜLLER TUBE AT LOW TEMPERATURES. N. H. Langton and P. P. Brown (National Coll. of Rubber Tech., London). J. Sci. Instr., 39: 136(Mar. 1962).

The performance of a Geiger-Mueller tube in experiments on the diffusion of organic liquids through rubber compounds is described. Since it was desirable to keep the samples at a low temperature during the counting period, the tube was placed in a variable refrigerator. Preliminary experiments showed that the counting rate decreased due to the formation of ice on the tube window and on the source. This was prevented by introducing a tray of drying agent into the refrigerator cavity. For α and β sources, the counting rate decreased as the temperature was lowered, the decrease being most marked down to 5°C. For lower temperatures there was little further change down to 40°C. The results show little sensitivity over the temperature range +20 to −10°C. This infers that the precautions taken to prevent ice formation appear to have been satisfactory. (P.C.H.)

13333 SECONDARY ELECTRON MULTIPLIERS IN NUCLEAR MEASURING TECHNIQUES. Rudolf Reichel (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Jenaer Rundschau, 6: 117-21(June 1961). (In German)

The uses of electron multiplier tubes in the detection and measurement of radiation are described. Compton anticoincidence and subtraction spectrometers are discussed and diagrams shown. Examples of measurements are given. (M.C.G.)

13334 ELECTRON MICROSCOPE OBSERVATION OF ETCHED TRACKS FROM SPALLATION RECOILS IN MICA. P. B. Price and R. M. Walker (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev. Letters, 8: 217-19 (Mar. 1, 1962).

Tracks in mica, resulting from recoil nuclei produced in spallation reactions of 3.0-Bev protons, were observed using an electron microscope. Decay events may be observed on a shorter time scale, and observation of "fossil" cosmic-ray events may become possible. A chemical etching treatment providing a demonstration of localized radiation-induced corrosion was used. (L.N.N.)

13335 ON THE THEORY OF ELECTROSTATIC FLUXMETER OPERATION IN PLASMA. Ya. M. Shvarts. Radiotekh. i Elektron., 6: 153-9(Jan. 1961). (In Russian)

Radiotechnical methods are analyzed for increasing the signal-interference ratio of electrostatic fluxometers used in plasma. It is shown that a synchrotron detector scheme and feedback coupling along a constant intensity considerably increase the ratio. The maximum signal-interference ratio was evaluated. (tr-auth)

13336 SPIN OSCILLATOR. V. G. Veselago (Lebedev Inst. of Physics, Moscow). Radiotekh. i Elektron., 6: 849-51(May 1961). (In Russian)

The block-scheme of a spin oscillator with magnetic intensity H = 5000 gauss is given. The proton frequency in the H field is ~20.3 Mc. The field magnitude can be slightly altered by magnetized coils. The general frequency characteristics of the whole circuit, including the bridge with specimen and the amplifier, is exhibited. (R.V.J.)

13337 LIQUID HELIUM SCINTILLATION COUNTER AS A NEUTRON POLARIMETER. J. E. Simmons and R. B. Perkins (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 32: 1173-8(Nov. 1961).

A liquid helium scintillation counter was constructed and used in analyzing the spin polarization of neutrons in the range of energy near 20 Mev. Details of construction and operation of the device are described. The glass scintillation flask contains 8 moles of helium, and is supplied by a reservoir which provides 7 hours continuous operation under experimental conditions. The pulse-height spread for a source of natural alpha particles is approximately 25%. It is found that the attenuation of the helium scintillation light in the liquid is not appreciable at a distance of 10 cm, while the wavelength is observed to be less than 1600 Å. Consequently, use of a fluorescent material as a wave shifter within the helium flask is required. The intensity of the wave shifted helium light compares favorably with that from CsI(Tl). The helium counter is used in coincidence operation with a plastic scintillator neutron detector. Under these circumstances, the width of a grated helium recoil pulse-height distribution is generally less than 30%. The geometry and electronics for a typical neutron polarization experiment are described. (auth)

13338 SCINTILLATION DETECTOR OF 4-m^2 AREA AND TRANSISTORIZED AMPLIFIER WITH LOGARITHMIC RESPONSE. Koichi Suga, George Clark, and Ismael Escobar (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 32: 1187-9(Nov. 1961).

A scintillation detector with an area of 4 m^2 and a transistorized amplifier with a logarithmic height-to-time converter are described. The detector employs tapered sheets of plastic scintillator and a single 16-in. photomultiplier mounted in a pyramidal can, coated inside with a commercial 90% reflecting white paint. The response is uniform to within 5% over the entire sensitive surface. A traversal by one relativistic charged particle (energy loss ~10 Mev) generates approximately 20 photoelectrons in the photomultiplier. The amplifier and converter yield a rectangular pulse whose duration is accurately proportional to the logarithm of the input pulse amplitude over a range of four decades. The gain is constant to 1 db from 10 to 45°C, and the equivalent noise input is 200 μv. (auth)

13339 AVALANCHE TRANSISTOR CIRCUITS. W. Michael Henebry (Univ. of Illinois, Urbana). Rev. Sci. Instr., 32: 1198-1203(Nov. 1961).

The evolution of avalanche circuits, which retain the desirable features but which do not suffer from the two defects of the basic avalanche circuit: low duty cycle, and a pulse propagation delay which is dependent upon input, is described. Several transistor types which are suitable for fast avalanche circuits are compared and comments are made about the application of these transistors. Described also are several circuits which may be constructed with avalanche transistor techniques. (auth)

13340 SHORT DEAD-TIME CORONA-STREAMER COUNTER FOR NEUTRONS. A. J. Tavendale (Univ. of Tasmania, Hobart, Australia). Rev. Sci. Instr., 32: 1205-8(Nov. 1961).

The long dead time and cathode erosion of the Rosenblum corona-spark counter for heavily ionizing radiations were overcome by forming only the streamer stage of the spark by the addition of a few percent of some diatomic gas to nitrogen-contaminated argon in corona detectors of coaxial wire-cylinder geometry. The amplitude of the streamer pulse at the anode wire is large (>10 v) and distinctly greater than background, with a risetime of about 1 μsec. The recovery of the anode potential is made rapid (typically 5 μsec) by a simple RC anode circuit. Efficiencies for streamer formation of 7.5% for U^{234} α particles, 1.5% for (n,B^{10}) α's, and 5% for (n,U^{235}) fission fragments were obtained in coated counters. (auth)

13341 THREE-PARAMETER MULTICHANNEL RECORDER-ANALYZER SYSTEM. Curtis C. Rockwood and Michael G. Strauss (Argonne National Lab., Ill.). Rev. Sci. Instr., 32: 1211-21(Nov. 1961).

A system is described in which nuclear events characterized by three parameters are recorded in digital form on magnetic tape by the record station. The completed tape is then analyzed off-line by the search station. Events of a typical experiment may consist of two pulse heights and a neutron time-of-flight, two pulse heights and an angle, or three coincident pulse heights. Each parameter is encoded by eight binary characters (bits) or 256 channels; thus, the number of different combinations is $(256)^3$ or approximately 17×10^6. Each event is recorded as three eight-bit numbers across a 24-track, 1¼-in. magnetic tape. The tape is advanced in steps of 0.01 in. per event at low counting rates in order to conserve tape, and is moved continuously at high counting rates in order to achieve a recording rate of 170 events per second. During search of the recorded tape, restrictions are imposed on two parameters. If both are satisfied, the third variable of the corresponding event is tallied in one quadrant of a 1024-word core memory. There are four restriction gates, one for each memory quadrant. In a neutron experiment, for example, a single pass of a 2500-ft tape with 3×10^6 events lasts only 3½ min and produces four time-of-flight spectra, each with uniquely selected energy ranges of two coincident gamma rays as parameters. The four spectra may be viewed on a cathode-ray tube or read out simultaneously by a typewriter, punched paper tape, and X-Y recorder at a rate of 5 min per spectrum of 256 channels. For experiments with low coincident counting rates, this system provides an efficient method for accumulating and analyzing data. The entire system is made with solid-state components, including 2100 transistors and 3300 diodes. (auth)

13342 TUNNEL DIODE NANOSECOND COINCIDENCE CIRCUIT. Paolo Franzini (Columbia Univ., New York). Rev. Sci. Instr., 32: 1222-3(Nov. 1961). (NEVIS-95)

A fast coincidence circuit using tunnel diodes is described. In ideal conditions, resolving times as low as 0.5 nsec were measured. But in a practical case of beam particles crossing scintillation counters, a typical resolving time is ≈1.5 nsec. The same circuit can also be used as an anticoincidence whose total dead time can be as low as 5 nsec. (auth)

13343 OXIDE STABILIZED SURFACE BARRIER DETECTORS. G. Amsel (Ecole Normale Supérieure, Paris). Rev. Sci. Instr., 32: 1253(Nov. 1961).

Advantages and disadvantages of surface barrier charged particle detectors are given. Discussion is also given on the working mechanism of the detectors and certain facts were established. Anodic oxidation was found to produce very stable detectors, but the series resistance introduced by SiO_2 film is high and leads to a long rise-time of pulses and poor resolution. Therefore, the deposition of a thin film of conducting oxide was considered. Detectors produced this way appeared to be much more stable in high vacuum and results are more reproducible. It was concluded that the use of conducting oxides as electrodes on surface barrier detectors should be systematically investigated. (P.C.H.)

13344 VARIABLE GUARD METHOD FOR THE REDUCTION OF LEAKAGE AND ION COLLECTION IN ELECTROMETER SYSTEMS. J. Nicholls (Dept. of National Defence, Defence Research Chemical Labs., Shirley Bay, Ottawa). Rev. Sci. Instr., 32: 1255-6(Nov. 1961).

A standard logarithmic grid circuit for grid switching was adapted, and both stray ion collection and leakage were significantly reduced by using a guard system adjusted by making the voltage V_0 equal to that of the floating grid. The reduction in leakage is determined by the precision with which V_0 can be adjusted, but, in general, the reduction can easily be made sufficient to allow the use of standard ceramic switch wafers. The reduction in ion collection is a function of geometry as well as potential difference, and some further advantage can be gained by making certain that the stray collecting volume operates well below saturation under all conditions. The limitations of the method were tested. (P.C.H.)

13345 QUALITATIVE TEST OF THE INERTNESS OF GAS TO COVER SODIUM–POTASSIUM ALLOYS. E. K.

Inall (Australian National Univ., Canberra). Rev. Sci. Instr., 32: 1257-8(Nov. 1961).

A sampling device, which consists of a glass envelope enclosing a glass blow, was designed for cleaning NaK surfaces. The surface in the bowl can be cleaned by passing a 20 amp current between two electrodes, so that NaK is pumped up through the tube into the bowl. Intermittent operation of the pump was found to be more effective than continuous operation, so the pump is run three or four times for intervals of about 10 sec. This produces a clean surface on the NaK in the bowl, if the gas is free of any reactive contaminants, or if the gas has been pumped out, leaving a pressure of less than 1 mm Hg, so that the remaining contamination is rapidly removed by reaction with the NaK. Two conditions that hinder the cleaning are: a heavy deposit of oxide, which is difficult to dislodge from the bowl; and when the envelope is evacuated, bubbles of low pressure gas form between the glass and the NaK and break the contact to one of the electrodes. However, both conditions can be overcome to a great extent if the tester is shaken from side to side. (P.C.H.)

13346 HIGH ENERGY BEAM PROFILE DETECTORS FOR LOW FLUXES. Leona Marshall (New York Univ., New York and Brookhaven National Lab., Upton, N. Y.) and A. Wattenberg. Rev. Sci. Instr., 32: 1258-9(Nov. 1961). (BNL-5544)

Encouraging results in attempts to obtain detectors for secondary beams of π mesons were obtained visually by using large prisms of NaI separated from each other by aluminum foil. Pulsed beams of 10^4 particles/cm^2 in a few milliseconds produced visible flashes of light in the matrix. Two detectors, both in the form of a matrix of scintillating rods, each piece surrounded by aluminum foil, were constructed. Discussion is given on the advantages and disadvantages of the two systems. Photographs were made of the light flashes and were most useful in setting the currents in the beam deflecting magnets and also in checking the position of the beam for the placement of targets, shielding, and detectors. However, due to poor contrast and resolution, it is only a semiquantitative device. (P.C.H.)

13347 SIMPLE TUNNEL DIODE COINCIDENCE CIRCUIT FOR LIQUID SCINTILLATION COUNTING. M. Kanter and U. Galil (Weizmann Inst. of Science, Rehovoth, Israel). Rev. Sci. Instr., 32: 1259-60(Nov. 1961).

A fast tunnel diode discriminator and coincidence circuit, connected directly to the output of two photomultipliers, was built to avoid the need of using an amplifier. Each discriminator consists of one tunnel diode with a switching time of 0.5 nsec. The triggering level was changed from 10 mv to one volt by changing the supply voltage V_B from 150 to 90 mv. Measurements were made with two photomultipliers viewing a 20 ml liquid scintillator (toluene; 6 g/l PBD; 100 mg/l POPOP), using a series of sources in the energy range from Co^{57} to Co^{60}. It was found that it would be more convenient to work with high gain photomultipliers, since, with the ones used, work had to be done at the maximum recommended tube ratings to obtain the required output current. (P.C.H.)

13348 SPINNING ROTOR PRESSURE GAUGE. J. W. Beams, D. M. Spitzer, Jr., and J. P. Wade, Jr. (Univ. of Virginia, Charlottesville). Rev. Sci. Instr., 33: 151-5 (Feb. 1962).

A magnetically suspended rotor pressure gage is described for measuring pressures below 10^{-4} torr. The data are in agreement with those obtained with a calibrated ionization gage over the range 10^{-4} to 5×10^{-9} torr. When the gas in the vacuum system is frozen out with liquid helium, the rotor gage records a residual pressure of about 5×10^{-10} torr. A brief discussion is given of a number of effects that may introduce errors into the measurements at the lowest pressures. (auth)

13349 PRECISION CONTINUOUS CURRENT INTEGRATOR. R. C. Mobley (Lousiana State Univ., Baton Rouge). Rev. Sci. Instr., 33: 177-80(Feb. 1962).

An all-electronic precision current integrator for use with a charged-particle accelerator is developed, which eliminates the substantial deadtime normally associated with multicycle current integrators utilizing relays as their basic switching elements. Integration is accomplished in the conventional fashion of charging a precision condenser with the current to be integrated, electronically noting the completion of a predetermined voltage excursion, and then returning the condenser to its initial charge state for repetition of the cycle. A unique feature of this integrator is the return of the integrating condenser to its initial charge state through the transfer of a precise amount of negative charge to the condenser by an all-electronic charge transfer circuit. Integration continues during the charge transfer with no interruption and with no effect on the precision of integration. An electronic counter circuit interrupts the integration at the end of a preset number of cycles and gates off any associated equipment. Current range is approximately 1 to 500 μa. Accuracy at low currents is limited primarily by a total circuit leakage current of the order of 1.5×10^{-9} amp. At higher currents, electrometer and other circuit instabilities limit accuracy to slightly better than 0.01%. (auth)

13350 LABORATORY PRODUCTION OF HOT DENSE GASES. George T. Lalos (Naval Ordnance Lab., White Oak, Silver Spring, Md.). Rev. Sci. Instr., 33: 214-18(Feb. 1962).

A ballistic piston compressor is described that makes possible the study of gases at simultaneously extremely high values of density and temperature, under conditions of pure thermal excitation, and in the absence of external electric or magnetic fields. Calculations are presented that demonstrate the density-temperature-pressure relations. Preliminary results are given of a current study of density and temperature effects on spectral line width, shape, and position of a diffuse series line (4603 Å) and a sharp series line (4972 Å) of Li caused by collisions with He and Ar atoms. (auth)

13351 LIQUID HYDROGEN BUBBLE CHAMBER FOR LOW ENERGY NUCLEAR PHYSICS. E. R. Flynn and P. J. Bendt (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 33: 223-9(Feb. 1962).

The bubble chamber contains 3.2 liters of liquid hydrogen and has two vertical and two horizontal windows 4 in. in diameter, which are used for 90° stereophotography. The energy and scattering angle of recoil protons from 5 to 38 Mev can be measured. As a neutron spectrometer, the chamber has an efficiency of 8×10^{-3} recoil protons in the zero-to-30° forward cone per incident neutron, at 22.5 Mev. The peak of the energy distribution has a full width at half maximum of 1.3 Mev, and the background is about 4%. The average scanning rate is 2000 tracks per man-week. A description of the apparatus and track-measuring equipment is given. (auth)

13352 TRANSISTORIZED SERIES REGULATOR FOR ANALYZING MAGNET. Charles A. Steggerda (Univ. of Maryland, College Park). Rev. Sci. Instr., 33: 244-6 (Feb. 1962).

A current regulator is described whose purpose is to eliminate noise in a motor-generator and beam-analyzing magnet system. Current variations are transformed into voltage variations and amplified. The output of the amplifier controls the transistorized series regulator, producing a voltage that exactly cancels the brush noise of the generator. Means are described whereby voltages across the transistors are kept below 15 v. The regulator reduces fluctuations to less than 33 ppm. (T.F.H.)

13353 METHOD OF CONSTRUCTING THIN-FOIL SPARK CHAMBER PLATES. David R. Nygren (Univ. of Washington, Seattle). Rev. Sci. Instr., 33: 252(Feb. 1962).

A method is described for stretching 3-mil Al foil over 20 × 56 in. Al frames, and bonding the foil to the frame with epoxy resin. The method is intended to be used for fabricating spark-chamber foils. (T.F.H.)

13354 CIRCUITS TO OPERATE A SCINTILLATION SPECTROMETER PROBE WITH SINGLE CONDUCTOR CABLE. Gordon K. Riel and Henry Irons (Naval Ordnance Lab., White Oak, Md.). Rev. Sci. Instr., 33: 254-5(Feb. 1962).

A circuit is described for operating a photomultiplier tube and preamplifier from a single-conductor armored cable. The conductor supplies power to the phototube and transistorized preamplifier, and returns signals to a multichannel analyzer. The armor acts as shield and ground. The phototube and preamplifier may be used under water. (T.F.H.)

13355 SEMICONDUCTOR AND GAS-ION-CHAMBER DETECTOR SYSTEM FOR THE MASS IDENTIFICATION OF 10- TO 30-MEV PARTICLES. H. E. Wegner (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 33: 271-7(Mar. 1962).

A charged-particle detector system, which consists of a gas-ion-chamber ΔE counter and a semiconductor E counter, is described. The detector system was employed in the study of nuclear reactions leading to protons, deuterons, tritons, He^3, and alpha particles in the 10- to 30-Mev region, with mass and charge identification for each kind of detected particle. Although many particles have sufficient energy to penetrate beyond the sensitive depletion region of the semiconductor detector, the electronic selection system discriminates effectively against such particles. Those particles ending their range in the depletion region may be studied under conditions of energy resolution and mass discrimination much improved over the usual NaI scintillation detector system. Preliminary results of measurements with a lithium-drifted p-i-n junction with a depletion region 2 mm thick are shown, and the advantages of using the thicker depletion region available with such devices with the same electronic system are demonstrated. (auth)

13356 PANORAMIC MASS SPECTROMETER. D. G. H. Marsden (Université Laval, Quebec). Rev. Sci. Instr., 33: 288-93(Mar. 1962).

A panoramic rapid scanning sector mass spectrometer is described. A mass range of ten to one may be scanned in times ranging from 10 msec to 300 μsec; the peaks are displayed on the screen of an oscilloscope. Alternatively, single peak height variations may be displayed down to times of 10 μsec. The instrument is designed for following gas reactions at pressures up to 200 mm and the temperatures up to 450°C. Some comparison is made with fast-scanning time-of-flight instruments. (auth)

13357 "STRIPPER" MEASURING INSTRUMENT FOR RECORDING VARIATIONS OF THRESHOLD AND CHANNEL WIDTH. L. Binard and J. Vanhorenbeeck (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Rev. Sci. Instr., 33: 307-10(Mar. 1962).

The instrument described makes possible the investigation of the stability of a pulse height analyzer. It provides pulses whose amplitudes, adjusted by a feedback circuit, follow the two boundaries of a channel. The connection from the analyzer to the pulse generator is made by a double rate meter circuit which enables the simultaneous recording of the threshold and channel-width variations of a pulse height analyzer. (auth)

13358 EXPERIMENTS WITH FLUORESCENT X RAYS IN THE 10- TO 50-Å WAVELENGTH REGION. L. G. Dowell and O. E. Berwaldt (Linde Co., Tonawanda, N. Y.). Rev. Sci. Instr., 33: 340-1(Mar. 1962).

Apparatus for the production, dispersion, and detection of soft fluorescent x rays (10 to 50 Å) is described. The apparatus includes a new type of gaseous discharge x-ray tube capable of operating at 3000 v and 200 ma, a servo-type vacuum controller for maintaining constant x-ray tube current, and built-up films of heavy-metal soaps for use as analyzing crystals. Photographs are included of fluorescent spectral lines of carbon from graphite (Kα, λ = 44.5 Å) and of copper (Lα, λ = 13.3 Å) obtained, respectively, in 2 and in 4.5 hr. (auth)

13359 SILICON SOLAR CELLS AS VERSATILE RADIATION DOSIMETERS. W. Rosenzweig (Bell Telephone Labs., Inc., Murray Hill, N. J.). Rev. Sci. Instr., 33: 379-80(Mar. 1962).

The use of a silicon solar cell to measure high-intensity radiation is discussed. The ionization rate in the sensitive volume is determined by measuring the short-circuit cell current, and intensities as low as 10^2 rad/hr can be measured. A depth dose curve is plotted for aluminum with a 1.07-Mev electron beam. Minimization of the radiation damage due to very intense radiation is discussed. (D.L.C.)

13360 LITHIUM ION DRIFT SEMICONDUCTOR DETECTOR AS A BETA-RAY SPECTROMETER. Harry I. West, Jr. (Univ. of California, Livermore), Fred P. Burns, Louis Wang, and Frank P. Ziemba. Rev. Sci. Instr., 33: 380-2(Mar. 1962). (UCRL-6646-T)

Response curves are given for silicon p-n junction and lithium ion drift semiconductor detectors to monoenergetic electrons. The problems involved with the lithium drift detector are discussed: poor resolution at less than maximum depletion, an intermediate peak for high-energy electrons, and insensitive surface layers. The advantages of the lithium drift detector are reliability and low background. (D.L.C.)

13361 SINGLE TUBE NUCLEAR QUADRUPOLE SPECTROMETER FOR CHLORINE AND NITROGEN. K. E. Weber and J. E. Todd (Univ. of Cincinnati). Rev. Sci. Instr., 33: 390-1(Mar. 1962).

The vibrating-plate capacitor used in r-f spectrometers to obtain frequency sweep is replaced with a voltage-variable capacitor, which is essentially a semiconductor diode with a moderately large capacitance. A circuit diagram is given for a superregenerative spectrometer incorporating a diode modulator for chlorine resonances at 20 to 38 Mc. Circuit modifications for lower frequency applications, e.g., for nitrogen resonances, are described. (D.L.C.)

13362 EFFECT OF OPTICAL COUPLING ON TIME RESOLUTION IN A FAST COINCIDENCE CIRCUIT. D. P.

Kerr and B. G. Hogg (Univ. of Manitoba, Can.). Rev. Sci. Instr., 33: 391-2(Mar. 1962).

During positron decay experiments, a deterioration of the time resolution was observed and found to be due to poor optical coupling between the photomultiplier and the phosphors. Time resolution curves are given for both poor and good optical coupling. (D.L.C.)

13363 REFRIGERATION PLANT FOR THE TWO-METRE HYDROGEN BUBBLE CHAMBER OF THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN). F. Schmeissner (European Organization for Nuclear Research, Geneva) and J. Haenny. Sulzer Tech. Rev., 43: No. 3, 12-16(1961).

A closed-circuit H_2 refrigeration plant with a refrigeration output of 4 kw obtained exclusively by the expansion of gas in turbines is described. The working principle of bubble chambers is explained, and some technical data of the CERN two-meter chamber are given. (auth)

13364 ELECTRONIC MINIATURIZATION (SUPPLEMENT TO CTR-250). OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Dec. 1961. 14p. (SB-444)

A bibliography of reports listed in the OTS semimonthly abstract journals is presented. (About 150 references.) (J.R.D.)

13365 CATHODE RAY POLAROGRAPH. Herbert MacDonald Davis and Joyce Elizabeth Seaborn (to United Kingdom Atomic Energy Authority). British Patent 891,988. Mar. 21, 1962.

A polarograph apparatus is designed in which a potential rising linearly with time is applied to the cell late in the life of each mercury drop and the ratio of the cell current to the voltage is recorded. The cycle of events takes place in sweep periods defined by a multivibrator. The d-c current in the cell is amplified by a rectified a-c amplifier, which makes it possible to make the apparatus no larger than a conventional laboratory oscilloscope. Two cells may be used together as a differential polarograph. (D.L.C.)

13366 NEUTRON DETECTOR INSTRUMENTATION. (to Bendix Corp.). British Patent 892,805. Mar. 28, 1962.

A neutron detection apparatus is designed whose instrumentation can be placed at a distance from the reactor. The apparatus comprises a detection chamber, a coaxial cable connected to the chamber output, and a transistorized current amplifier connected to the far end of the cable. By using a current amplifier instead of a voltage amplifier, the amplifier can be placed far from the reactor. (D.L.C.)

13367 METHOD AND APPARATUS FOR MEASURING RADIATION. Seth D. Reeder (to U. S. Atomic Energy Commission). U. S. Patent 3,030,510. Apr. 17, 1962.

A chemical dosimeter for measuring the progress of a radiation-induced oxidation-reduction reaction is described. The dosimeter comprises a container filled with an aqueous chemical oxidation-reduction system which reacts quantitatively to the radiation. An anode of the group consisting of antimony and tungsten and a cathode of the group consisting of gold and platnium are inserted into the system. Means are provided to stir the system and a potential sensing device is connected across the anode and cathode to detect voltage changes. (AEC)

13368 HIGH VOLTAGE, HIGH CURRENT SPARK GAP SWITCH. Robert S. Dike, Douglas W. Lier, Aldred E. Schofield, and James L. Tuck (to U. S. Atomic Energy Commission). U. S. Patent 3,030,547. Apr. 17, 1962.

A high voltage and current spark gap switch comprising two main electrodes insulatingly supported in opposed spaced relationship and a middle electrode supported medially between the main electrodes and symmetrically about the median line of the main electrodes is described. The middle electrode has a perforation aligned with the median line and an irradiation electrode insulatingly supported in the body of the middle electrode normal to the median line and protruding into the perforation. (AEC)

13369 VOLTAGE REGULATOR. R. L. Von Eschen and P. F. Scheele (to U. S. Atomic Energy Commission). U. S. Patent 3,031,608. Apr. 24, 1962.

A transistorized voltage regulator which provides very close voltage regulation up to about 180°F is described. A diode in the positive line provides a constant voltage drop from the input to a regulating transistor emitter. An amplifier is coupled to the positive line through a resistor and is connected between a difference circuit and the regulating transistor base which is negative due to the difference in voltage drop across the diode and the resistor so that a change in the regulator output causes the amplifier to increase or decrease the base voltage and current and increase or decrease the transistor impedance to return the regulator output to normal. (AEC)

Materials Testing

13370 (ORNL-TM-129) FUEL ELEMENT COOLANT CHANNEL AND OTHER SPACING MEASUREMENTS BY EDDY-CURRENT TECHNIQUES. C. V. Dodd and R. W. McClung (Oak Ridge National Lab., Tenn.). Mar. 20, 1962. Contract W-7405-eng-26. 20p.

The problem of making measurements of restricted spaces is presented and eddy-current techniques are proposed as a possible solution. Theory is presented. The design philosophy of test probes is discussed. Several probe styles are described and their application to inspection problems is shown. (auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

13371 (VDIT-54) URANIUM MINERALS IN SEDIMENTARY ROCKS AND SOME ASPECTS FOR THE GEOPHYSICAL AND GEOCHEMICAL PROSPECTION FOR THEM. A Literature Review. Ernst Bock (Aktiebolaget Atomenergi, Stockholm). Feb. 1962. 53p.

An annotated bibliography is presented, consisting of 113 references to material on U minerals in sedimentary rocks and geological, geochemical, and geophysical methods for prospecting for these deposits. (T.F.H.)

13372 (WT-1119) FALLOUT STUDIES. M. J. Schumchyk and E. H. Bouton (Chemical Warfare Labs., Army Chemical Center, Md.). July 23, 1958. Project 2.5.1 of Operation TEAPOT.

Ground and aerial radiation-intensity measurements were made of the radioactivity associated with the base surge fall-out, cloud fall-out, and crater-lip areas following an underground thermonuclear explosion at a depth of 67 ft with a yield of 1.2 kt. Data are presented on residual γ radiation fall-out patterns, time and rate of arrival of base surge and fall-out, the amount and distributions of radioactive materials associated with the base surge and fall-out, correlation of air and ground surveys to determine air to ground extrapolation data, variation of radioactive contamination in the crater and lip as a function of depth at varying distances from ground zero; gross β decay rates of radioactive fall-out materials, and particle characteristics of the fall-out material. (C.H.)

13373 TECTONISM, HYDROTHERMAL ZONING, AND URANIUM IN THE CENTRAL ANDES. [PART II]. John W. Gabelman (Atomic Energy Commission, Washington, D. C.). Bol. inform. junta control energia atomica (Peru), 6: 53-71 (Sept.-Oct. 1961). (In Spanish)

The discussion on the regional zoning, zoning in the Andes, the iron oxide zone, the copper zone, the primary and secondary metal-base zone, and the gold zone is continued. Then the occurrence of uranium is described. (J.S.R.)

13374 RADON DETERMINATION AS A PROSPECTING TECHNIQUE. J. D. Peacock and R. Williamson. Bull. Inst. Mining Met., 71: 271-7(Feb. 1962).

Discussion is given on the advantages, disadvantages, and the technique of radon determination in prospecting. It is pointed out that the technique of radon determination is not for primary prospecting on a regional scale, but that it is effective in locating uranium mineral deposits in favorable environments or in proximity to known ore bodies. It is also emphasized that, although the equipment provides results more quickly and at lower cost than other similar applications, the design discussed is capable of further development. Some of the ways in which improvements might be made are outlined. Discussion is also given on the prospect of wider applications of the technique for metals in general and on the question of alpha vs gamma anomalies. (P.C.H.)

13375 RADIOACTIVE CONTAMINATION OF SOIL. O. A. D. Trojan and K. G. McNeill (Univ. of Toronto). Can. J. Phys., 40: 370-2(Mar. 1962).

All soil samples came from the same location in King township, Ontario. For each test, a set of samples from a 500-cm^2 plot was taken. Each sample was dried, weighed, and its gamma activity measured using a 5-in. NaI(Tl) scintillation crystal. Activities detected, other than the naturally occurring ones, were Ru^{103}, Rn^{106}, Zr^{95}, Nb^{95}, and Cs^{137}. After spring, 1960, Cs^{137} was the only remaining fission product. In July 1961, the Cs^{137} dose rate was measured. (L.N.N.)

13376 A LEAD ISOTOPE STUDY DEFINES A GEOLOGICAL STRUCTURE. William F. Slawson and Carl F. Austin (Univ. of Toronto and New Mexico Bureau of Mines and Mineral Resources, Socorro). Econ. Geol., 57: 21-9(Jan.-Feb. 1962).

Isotopic constitutions of lead in galenas from West-Central New Mexico appear to be related to the location of the samples. Modern leads form a belt bounded on either side by anomalous leads. The modern lead belt extends for more than 130 miles and lies essentially along a line defined by the towns of Alamogordo and Socorro, New Mexico. Geologists have postulated a regional lineament to lie under the belt defined by the modern lead samples. This structure is known variously as the Zuni, Zuni-Sacramento, or New Mexico-Utah lineament. It is proposed that lead isotopes can show a rational geological control and thus should be among the interpretative tools of tectono-physicists and geologists. (auth)

13377 EVIDENCE FOR THE EXTREME AGE OF CERTAIN MINERALS FROM THE DOMINION REEF CONGLOMERATES AND THE UNDERLYING GRANITE IN THE WESTERN TRANSVAAL. L. O. Nicolaysen (Univ. of Witwatersrand, Johannesburg), A. J. Burger, and W. R. Liebenberg. Geochim. et Cosmochim. Acta, 26: 15-23 (Jan. 1962). (In English)

Isotopic composition of galenas from the Witwatersrand indicated the existence of a hypothetical parent uraninite in this region; it was surmised to have originally crystallized ~3000 million years ago, and to have suffered alteration and expulsion of radiogenic lead later in its history. New age data are presented here for samples of total rock, and purified detrital monazite, from the Dominion Reef conglomerates which lie below the Witwatersrand System. These data give very strong evidence that radioactive minerals in the Dominion Reef have an age of crystallization close to 3100 million years. They are probably the oldest well-dated radioactive minerals. The analysis of total rock samples appears to be an important approach to the study of uranium minerals in ancient conglomerates. Clear-cut evidence concerning the time of deposition of the Dominion Reef conglomerate is still lacking. (auth)

13378 LEAD ISOTOPIC COMPOSITIONS OF GALENAS FROM THE WITWATERSRAND AND ORANGE FREE STATE, AND THEIR RELATION TO THE WITWATERSRAND AND DOMINION REEF URANINITES. A. J. Burger (National Physical Research Lab., C.S.I.R., Pretoria), L. O. Nicolaysen, and J. W. L. de Villiers. Geochim. et Cosmochim. Acta, 26: 25-59(Jan. 1962). (In English)

New Pb isotopic analyses are presented for forty-one galenas from various mines in the Witwatersrand and the Orange Free State. Certain of the galenas have large proportions of radiogenic lead, and one sample from the St. Helena mine contains a spectacular variation in the proportions of the lead isotopes within a hand specimen. The addition of radiogenic lead to these galenas is probably complementary to the loss of radiogenic lead from the Witwatersrand uraninites, and the implications of this

hypothesis on the uraninite age measurements are pursued. The possible times of abstraction of radiogenic lead from the uraninites were obtained through graphical analysis of the galena data. The hypothesis implies the former existence of parent uraninite grains, which have undergone chemical alterations; in this view the present Witwatersrand uraninites have maintained textural identity with the parent uraninites, but have been rejuvenated chemically through successive alterations and losses of radiogenic lead. The most probable age of crystallization of the parent uraninites is ~3000 million years. This is in agreement with an independent investigation of uraninites from the Dominion Reef, which are probably representative of the parent uraninites. The effect of mineral separation procedures in concentrating the uraninites for age measurement is also discussed. (auth)

13379 RADIOGENIC ARGON AND STRONTIUM DIFFUSION PARAMETERS IN BIOTITE AT LOW TEMPERATURES OBTAINED FROM ALPINE FAULT UPLIFT IN NEW ZEALAND. P. M. Hurley, H. Hughes, W. H. Pinson, Jr., and H. W. Fairbairn (Massachusetts Inst. of Tech., Cambridge). Geochim. et Cosmochim. Acta, 26: 67-80 (Jan. 1962). (In English)

Rapid uplift along the Alpine Fault zone in New Zealand exposed ancient mica schists which are estimated to have been at depths up to 9000 ft prior to the fault displacement, on the assumption that the smooth surface represented by the present, flat topped, peak elevations is truly representative of the mature Pliocene surface prior to uplift and glaciation. K–Ar age measurements on the micas show losses of radiogenic argon that vary with depth of burial up to almost complete loss from biotite at a depth of 9000 ft. The mean value of the diffusion parameter (D/a^2) calculated is 6×10^{-16} sec^{-1} at an estimated temperature of 110°C. This value is much higher than expected but is compatible with effectively complete retention of argon at surface temperatures, and with measured diffusion losses at high temperatures, if in the relationship $D/a^2 = (D_0/a^2) \exp(-E/RT)$ $D_0/a^2 = 1$ sec^{-1} and E = 27 Kcals/mole. A single Rb–Sr analysis on one of the low argon biotite samples showed an almost equal loss of radiogenic Sr^{87}. (auth)

13380 METEORITIC AND TERRESTRIAL RARE EARTH ABUNDANCE PATTERNS. S. R. Taylor (Australian National Univ., Canberra). Geochim. et Cosmochim. Acta, 26: 81-8(Jan. 1962). (In English)

Previously determined relative abundances of the rare earths in chondrites were found to differ from those in most common terrestrial rocks. Attention is drawn to a set of determinations in casic igneous rocks in which the pattern is similar to the chondritic abundance relations. It is concluded that the earth and chondrites contain similar relative amounts of the rare earths, and that those of lower atomic number have been selectively enriched in crustal rocks. This fractionation is attributed to differences in the radii of the trivalent ions. (auth)

13381 K/Rb RATIOS IN THE EVOLUTION OF THE YOUNGER GRANITES OF NORTHERN NIGERIA. J. R. Butler, P. Bowden, and A. Z. Smith (Imperial Coll. of Science and Tech., London). Geochim. et Cosmochim. Acta, 26: 89-100(Jan. 1962). (In English)

K/Rb ratios were determined in about 70 granites from Northern Nigeria. It is shown that late stage rocks such as albite–riebeckite–granites have ratios below 30 while early-stage rocks such as Ca–amphibole–granites can have ratios up to 330; biotite–granites have intermediate ratios. In the Liruei complex the ratio decreases progressively with time of emplacement but in the Amo complex the ratio varies irregularly. (auth)

13382 INTENSITY AND SPECTRAL ANALYSIS OF γ EMISSION OF MARINE WATER. V. N. Lavrenchik and G. N. Sofiev. Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 2, 275-8(Feb. 1962). (In Russian)

Measurements in the north-west section of the Indian Ocean indicate that K^{40} decay is responsible for most of the γ emission in ocean water, while precipitated K^{40} and Ra^{226} are responsible for the γ emission at the bottom. The γ intensities at the surface and at the bottom are nearly identical. The γ intensity of intermediate water is about 30% of the surface intensity. (R.V.J.)

13383 DETECTING NUCLEAR TESTS IN SPACE AND UNDERGROUND. New Scientist, 13: 742-5(Mar. 29, 1962).

A review is given of detection problems which arise in space and underground and the detection methods being studied. The capability of a detection system for nuclear tests in space is defined as the extreme range at which a nuclear explosion of a given yield can be detected with very little ambiguity. It is governed by three factors: the level and character of the weapon signal received, the noise background, and the statistics of natural events which can lead to false alarms. In the case of underground explosions, the only detection method which can be used at long distances is the observation of the seismic signal. Criteria which help in the discrimination of earthquakes from explosions are discussed. (P.C.H.)

13384 MEASUREMENTS OF THE WATER VAPOUR, TRITIUM AND CARBON-14 CONTENT OF THE MIDDLE STRATOSPHERE OVER SOUTHERN ENGLAND. F. Brown (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.), P. Goldsmith, H. F. Green, A. Holt, and A. G. Parham. Tellus, 13: 407-16(Aug. 1961). (In English)

Measurements of the water vapor, tritium, and carbon-14 content of the stratosphere at heights of between 80000 and 100000 feet, made over England during the years 1956-60, are described. The tritium and carbon-14 concentrations are greater than those expected from natural production due to the cosmic radiation. The bulk of these two isotopes, at present in the stratosphere, was injected there during the course of thermonuclear explosions. Mass spectrometric analyses show that the deuterium/hydrogen ratio of the water and the C^{13}/C^{12} and O^{18}/O^{16} ratios of the carbon dioxide collected at these heights were the same, within the accuracy of measurement, as those for samples collected near the ground. The concentration of tritium at the heights of the measurements has not fallen since the termination of thermonuclear weapon testing in autumn 1958. There is poor correlation between the tritium concentration at 90000 feet and that of particulate cesium-137 at 47000 feet measured over the sampling period. The humidity above 80000 feet was found to be greater than that in the lower stratosphere. It is concluded from the humidity and tritium results that the large scale meridional circulation in the stratosphere does not reach heights of 90000 feet over temperate latitudes. (auth)

13385 URANIUM-BEARING COAL IN THE CENTRAL PART OF THE GREAT DIVIDE BASIN. George N. Pipiringos (Geological Survey, Washington, D. C.). Geological Survey Bulletin 1099-A. 1961. 110p., 5 illus. (GPO)

Nearly 24 townships in the central part of the Great Divide Basin, Sweetwater County, Wyo., were mapped. Fourteen of these townships contain outcrops of uranium-

bearing coal. Thirty coal beds were mapped but only seven of them have uranium-bearing coal reserves as defined in this report. Coal beds 2.5 feet or more thick are considered in calculating coal reserves and, of these, only beds containing 0.003% or more uranium are considered in calculating the uranium content of coal. The uranium content of coal ash was estimated for those beds 2.5 feet or more thick that contain 0.015% or more uranium in coal ash. Measured and indicated coal reserves in the area total about 730 million short tons and contain about 2,700 short tons of uranium in the coal, or about 2,500 short tons of uranium in the coal ash. Strippable coal (in beds beneath 60 feet or less of overburden) includes about 250 million short tons of coal containing about 1,100 short tons of uranium in coal, or about 650 tons of uranium in coal ash. (auth)

13386 BULLETIN OF THE ATMOSPHERIC RADIOACTIVITY, NO. 25, APRIL-JUNE, 1961. Tokyo, The Japan Meteorological Agency, 1962. 87p. (In English and Japanese)

Tables are presented of atmospheric radioactivity in Japan through the period April to June, 1961. Data are presented from measurements on a temporary standard sample (U_3O_8) at each station, mean radioactivity in rain collected daily, radioactivity in the initial 1 mm of rain, radioactivity in large amount of rain and falling dust, and radioactivity in airborne dusts collected by dust collectors. (N.W.R.)

HEALTH AND SAFETY

Refer also to abstracts 12840, 12841, and 13860.

13387 (AD-261739) NUCLEAR WEAPON CASUALTIES—EFFECTS ON PERSONNEL. Final Report. (Smith (E. H.) and Co., Silver Spring, Md.). May 1, 1961. Contract AF33(600)-39304. 156p.

Early casualty data (0 to 8 hr) for very high neutron plus gamma doses are given. An equation is given for calculating effective dose at time t under an irradiation rate varying with t for total-body or partial-body irradiation. The relative values of the RBE's of photons and neutrons are discussed. A discussion is presented of the effects of clothing and of exposure to pulses of irradiation from large weapons. Pertinent data on thermal burn casualties are tabulated. The critical translational speed for injury is shown to be 20 ft/sec. The critical overpressure for serious injury or death to personnel in rooms or buildings is found to be about 5 psi. The speeds attained by men and missiles are given as functions of the drag coefficients and the blast overpressures. The critical overpressure for direct blast injury is found to be 35 psi. The problems posed by combined thermal-nuclear injury are described. (T.F.H.)

13388 (AD-264022) ATTENUATION OF GAMMA RADIATION THROUGH TWO-LEGGED RECTANGULAR DUCTS AND SHELTER ENTRANCEWAYS—AN ANALYTICAL APPROACH. J. C. LeDoux and A. B. Chilton (Naval Civil Engineering Lab., Port Hueneme, Calif.). Jan. 20, 1961. 50p. (TN-383)

An analytical approach is developed to permit determination of gamma radiation attenuation as it passes through two-legged rectangular ducts and shelter entranceways. The approach used employs the albedo concept for wall scattering and includes correction terms necessary to account for the "corner lip effect." With appropriate simplifying assumptions, moderately simple engineering formulas are obtained. Actual use of the formulas requires better knowledge of differential angular albedo than is presently available; however, by assuming isotropic distribution of the albedo function, a very good comparison of results calculated by this technique with experimental information is obtained. (auth)

13389 (AERE-R-3783) THE DETECTION OF AIRBORNE PLUTONIUM HAZARDS. P. Iredale and G. Hinder (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Harwell, Berks, England). Jan. 1962. 26p.

The detection of the very low levels of activity that constitute an airborne plutonium hazard is limited in practice to methods based on α-activity measurement, and assessment of maximum permissible concentrations for long-term exposure is made more difficult because of the large variable background of α-activity produced by the decay of the products of radon and thoron. Two instruments are investigated, both of which make corrections for the activities of these naturally occurring products and improve the threshold sensitivity of air sampling monitors. In the first, the activity of radon and thoron derivatives on a filter paper is estimated for the count rate for a β-α coincidence and this is used to compensate the total α-count rate for the contribution of the natural activities. The second method distinguishes the 5.1-Mev α-particle of plutonium from the background α-emitters by spectrometry, using a CsI crystal. In a further refinement of this method there is a compensation for that part of the count rate in the plutonium channel caused by α-particles of degraded energy. The necessary compensation is estimated from a measure of the total α-activity above 6.0 Mev energy. (auth)

13390 (AF-SAM-61-67) DEVELOPMENT OF PHOTOREACTIVE MATERIALS FOR EYE-PROTECTIVE DEVICES. Richard E. Fox (National Cash Register Co., Dayton, Ohio). Apr. 1961. 38p. (AD-261608)

The development and selection of materials that afford aircrew members eye protection from intense light-flashes such as occur during nuclear detonations are reviewed. Synthetization of photochromic materials affords over thirty compounds reactive to ultraviolet light. Spectral sensitivity measurements indicate that color formation is dependent upon the intensity of the activating light. Photo-induced ring closure (loss of coloring) is not observed in most photochromic compounds. Investigations of fatigue (gradual loss of photochromic properties) are outlined. Studies of thermal kinetics indicate that the rate of color loss is independent of concentration; water inhibits the rate of color loss; and the nature and position of molecule substituents affect the rate of color disappearance. Photochromic material in film undergoes rapid interconversion between the colorless and colored states, thereby demonstrating the possibility of a nonliquid photochromic filter. (auth)

13391 (FXM-3323) A DISCUSSION OF POSSIBLE MAJOR ACCIDENTS RESULTING FROM OPERATION OF THE SFR. C. Rotondo, C. Kardys, and R. Chapman (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Oct. 22, 1957. Contract [AT(11-1)-229]. 44p.

An evaluation of the possible energy release in Submarine Fleet Reactor power excursions was conducted to establish the ability of the Core Test Facility test cell to contain the fission products. Included are appendixes containing information on the force necessary to shear the control drum drive gears, equation of state determination for stainless steel, temperature history in UO_2 heat-generating particles, calculations concerning SFR accidents caused by rapid rotation of control drums with and without Na in the core, core meltdown calculations, temperature history of UO_2-stainless steel matrixes, startup accidents, and containment vessel pressure calculations. (J.R.D.)

13392 (NAA-SR-Memo-6872) NUCLEAR SAFETY IN HANDLING U–Zr COMPACTS. N. Ketzlach (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 16, 1961. Contract [AT(11-1)-Gen-8]. 6p.

Nuclear safety criteria are given for the handling of $1\frac{1}{2}$-in. by $1\frac{1}{2}$-in. compacts having a composition of 10 wt.% highly enriched U and 90 wt.% Zr. The maximum safe batch size for these compacts is 1.68 kg contained-U^{235}, independent of spacing between compacts or the degree of water flooding. For long compacts the maximum safe mass per unit length is 0.94 kg contained-U^{235}/ft of length. This, too, is independent of spacing between compacts or the degree of water flooding. Maximum safe batches containing no more than 1.68 kg U^{235} each are safe with a minimum edge-to-edge spacing of 20 in. (auth)

13393 VENTILATION DESIGN FOR FALLOUT AND BLAST SHELTERS. George M. Hama and William G. Frederick (Detroit Dept. of Health). Air. Eng., 4: 19-21 (Feb. 1962).

The ventilation requirements for fall-out and blast shelters are presented. Guides are given for sealing against infiltration, power sources, air requirements for persons in various states of activity, survival times for space volumes with no ventilation and occupants at rest, decay in fall-out radiation, and gamma radiation protection factors for various types of structures. The amount of construction material and monitoring equipment needed are also discussed. (N.W.R.)

13394 HOW TO ENGINEER AIR FOR A MUNICIPAL EMERGENCY CENTER. Donald G. Scripture (Scripture and Psihas, Inc. [Detroit]). Air. Eng., 4: 25-31(Feb. 1962).

The heating, ventilating, and air conditioning systems for the Livonia, Michigan, emergency disaster center are described. The general design requirements and problems are presented and discussed along with safety considerations, control sequence, and construction problems. The plumbing and power systems are also discussed. (N.W.R.)

13395 WHAT YOU SHOULD KNOW ABOUT RADIOLOGICAL INSTRUMENTS FOR SHELTERS. Fred R. Rhem (Radiological Defense Services, Milwaukee). Air. Eng., 4: 32-5(Feb. 1962).

Rate meters for measuring radioactivity in air, people, and things are described. Information is given on the method of monitoring, the range of various instruments, and the typical effects of short term exposures on humans. (N.W.R.)

13396 MODERN CONCEPTS OF AIR SAMPLING AND PROBLEMS FOR THE FUTURE. H. F. Schulte (Los Alamos Scientific Lab., N. Mex.). Am. Ind. Hyg. Assoc. J., 23: 20-5(Jan.-Feb. 1962).

It is felt that the basic principles of air sampling need to be elucidated. Special attention is given to recent developments and problems that need investigating in this field. Discussion is given on detector tubes, personal samplers to be worn by an individual, installed sampling systems, selective size samplers and associated equipment, movement of particles with reference to air flow line, application of statistics to sampling techniques, and evaluation of data. (P.C.H.)

13397 USE OF STATISTICAL METHODOLOGY IN ENVIRONMENTAL MONITORING. Gerald W. Kerr (Pratt & Whitney Aircraft, East Hartford, Conn.). Am. Ind. Hyg. Assoc. J., 23: 75-82(Jan.-Feb. 1962).

Objectives of the environmental monitoring program conducted at CANEL are presented with a description of the program as it is presently being conducted. Information on the selection of sampling locations and of a proper sampling frequency is given. Some new approaches using statistical methods in the analysis of environmental monitoring data are presented. Statistical methods including quality control techniques, t tests, and analysis of variance are described in relation to the analysis of data to detect significant changes and trends. (auth)

13398 PLANNING VENTILATION FOR NUCLEAR REACTOR FACILITIES. Bruce J. Held (Atomic Energy Commission, Idaho Falls, Idaho). Am. Ind. Hyg. Assoc. J., 23: 83-7(Jan.-Feb. 1962). (IDO-12018)

Problems and waste which result from poor design and lack of forethought in planning ventilation of industrial operations are discussed. A four-point program to achieve good initial design is presented: written required design criteria, review by separate responsible specialists for health and safety, periodic surveys and review of modifications, and written operating requirements. (auth)

13399 PROTECTION AGAINST RADIATION IN INDUSTRY. E. de Robien (Commissariat à l'Energie Atomique, Paris). Microtecnic, 15: 114-20(June 1961). (In English)

The inspection of industrial users of radiation sources in France is discussed. Potential hazards are reviewed and protective measures are outlined. (C.H.)

13400 THE ARTIFICIAL RADIOACTIVITY OF THE AIR AND OF PRECIPITATIONS. Hubert Garrigue (Observatoire du Sommet du Puy-de Dôme, Orcines, France). Compt. rend., 254: 151-2(Jan. 3, 1962). (In French)

The recrudescence of the artificial radioactivity of the atmosphere was observed at the summit of Puy de Dôme at soil level from precipitations and in flight in October and November 1961. The measurement results are tabulated and discussed. (tr-auth)

13401 INCREASED CONCENTRATION OF BERYLLIUM-7 IN THE STRATOSPHERE AFTER THE NUCLEAR TEST EXPLOSIONS DURING SEPTEMBER-OCTOBER 1961. J. F. Bleichrodt (National Defense Research Organization TNO, Rijswijk, Netherlands). Nature, 193: 1065-6(Mar. 17, 1962).

The results of 16 analyses of stratospheric samples for Be^7 and Sr^{89} are plotted on a Be^7 concentration vs Sr^{89} concentration graph. The samples were taken at 42,000 ft over the Netherlands between Sept. 25 and Nov. 27, 1961. The curve is a straight line, and if the natural Be^7 background is assumed to be constant, the equation may be used: $Be^7 = C + X\,Sr^{89}$, where C is the concentration of cosmic-ray-produced Be^7 and X is the disintegration ratio of artificial Be^7 and Sr^{89} at the time of explosion. From the slope of the curve, X is calculated to be 0.034. (D.L.C.)

13402 CAESIUM-136 IN RAIN AND IN MILK. A. Morgan (Atomic Energy Research Establishment, Harwell, Berks, Eng.), J. Rundo, H. D. Vandervell, and V. M. Emeleus. Nature, 193: 1150-1(Mar. 24, 1962).

The detection of Cs^{136} in rain and milk, following the extensive series of nuclear weapons tests held in September and October 1961, is reported. The best estimate made for the activity in rain water was 2.3 $\mu\mu$c per liter and 7 $\mu\mu$c per liter for Cs^{137} and Cs^{136}, respectively. Because of the efficient transfer of Cs^{137} from grass to milk, it seemed likely that Cs^{136} should be detectable in milk. Prominent peaks at 0.82 and 1.04 Mev revealed relative intensities in the same ratio as those from Cs^{136}. The identification of Cs^{136} in milk samples rests entirely on this evidence. An approximate estimate of the levels of Cs^{136} reached in the human body was derived with certain assumptions. (P.C.H.)

13403 A CUMULATIVE DEPOSITION OF FALL-OUT WITHIN BUILDINGS. A. R. Gould (Royal Military Coll. of Science, Shrivenham, Berks, Eng.). Nature, 193: 1152-3 (Mar. 24, 1962).

Simple observations confirmed the existence of a widespread preferential deposition of radioactive fall-out within buildings around doors and windows by inertial impact. Smear tests taken from a laboratory door showed a surprising quantity of material with an intense α activity. It was found that two major physical mechanisms of dust depositions by inertial impact and gravitational settling appear to result in quite different concentrations of fall-out. Deposits of dust by inertial impact exhibited considerable α activity with some 300 counts per hour from 5 cm^2 of

dust after allowing 72 hr for decay of natural radon and thoron daughter activity. Some 500 counts per min (primarily β's) were also detected. There appear to be two physical factors, impact efficiency and retention in high velocity air streams, within the restrictive orifices of buildings that result both in an increased rate of deposition and in concentration of fall-out by preferential deposition. It is suggested that dust samples may include greatly differing proportions of fall-out according to the nature of deposition: gravitational settling, impacted deposits, convected and thermal deposition, and ash. (P.C.H.)

13404 SOME CIVIL DEFENSE PROBLEMS IN THE NATION'S CAPITAL FOLLOWING WIDESPREAD THERMONUCLEAR ATTACK. Richard Bentz, William Chace, Gordon Doerfer, John Donaldson, Thomas English, James Graves, Paul Grim, David Gunlock, Jerome Horowitz, Leland Miller, and Albert Small (Johns Hopkins Univ., Chevy Chase, Md.). Operations Research, 5: 319-50(June 1957).

The probably conditions in Washington following widespread thermonuclear attack are assessed with respect to: radiation conditions in the city itself and in the surrounding areas, and deaths and debris conditions in the nation's capital. Mock attacks with thermonuclear-size bombs were made on all targets designated as critical by the FCDA within a 300-mile radius of Washington. Appropriate fall-out contours were selected and oriented as to wind speed and bearing for each target. The attacks were repeated 36 times using a random sample of actual 60,000-ft wind readings. Radiation levels for the area were then compiled in terms of the per cent of time a given two-day accumulated dose would be exceeded. An attack day was selected at random and the effects of blast heat and local (close-in) fall-out in Washington were added to indirect radiation effects. A comparison of the amount of time a rescue worker would have to wait (impeded by debris and radiation) to enter an area with the amount of time left to a survivor in shelter attenuating 0.9 of radiation effects was made. An area exists, in Virginia, where less than 200 r can be expected a large per cent of the time. A very small percentage of the target population will survive to be cared for in this area. It was found that present shelter is not adequate to prevent intolerable numbers of deaths. Present 'evacuation areas' should be re-evaluated in terms of likely radiation conditions. (auth)

13405 STRONTIUM-90 IN THE 1959 UNITED STATES WHEAT CROP. Theodore A. Olson, Jr. (General Mills, Minneapolis). Science, 135: 1064(Mar. 23, 1962).

A broad sampling of the 1959 United States wheat crop was analyzed for the presence of strontium-90. The level of strontium-90 found in these samples is in general agreement with the findings of other investigators, with the exception that the highest levels of strontium-90 in wheat were found in samples from Oklahoma. (auth)

13406 STRONTIUM-90 AND CESIUM-137 ABSORBED BY RICE PLANTS IN JAPAN, 1960. Ryushi Ichikawa, Masako Eto, and Michiko Abe (National Inst. of Radiological Sciences, Chiba City, Japan). Science, 135: 1072(Mar. 23, 1962).

The mechanism of radioactive cesium and strontium contamination of rice was investigated. About 60% of Sr^{90} contained in polished rice in 1960 is due to root absorption from soil. The amount of Cs^{137} absorbed by rice plants directly from fall-out during the period between ear-shooting and harvest is assumed to be about 20% of total Cs^{137} in the plant. (auth)

13407 STANDARD PROCEDURE FOR MEASUREMENT OF RADIOACTIVE AEROSOL CONCENTRATION BY THE FILTER METHOD. Karl-Heinz Weber and Wolfram Wisch (VEB Vakutronik, Dresden). Staub, 20: 393-8(Nov. 1, 1960). (In German)

The measurement of radioactive aerosol concentration is carried out frequently by enrichment with the aid of fibrous filters. Calibration can be carried out with the aid of surface preparations of known and homogeneously distributed activity and with a filter of similar absorption behavior with the same geometry. In the evaluation the differences in self-absorption caused by the exponential dust deposition in the filter must be taken into consideration. Corresponding correction factors are calculated as a function of the energy and of the collection efficiency and surface density of the filter. (auth)

13408 THE PREPARATION OF RADIOACTIVE LABELLED MEMBRANE FILTERS AND THEIR USE IN DUST MEASUREMENT TECHNIQUES. Kvetoslav Spurny and Gustav Kubie (Inst. for Physical Chemistry and Mining Inst., Czechoslovak Academy of Sciences, Prague). Staub, 20: 400-2(Nov. 1, 1960). (In German)

A method is described for producing membrane filters containing radioactive nickel. The membrane filters have an activity of about 0.05 $\mu c/cm^2$. They are employed in the separation of aerosols where the quantity of collected material is determined by absorption of β radiation. The lower limit of sensitivity for the method is 0.2 mg/cm^2. The possibility of constructing an automatic measuring apparatus for rapid determination of aerosol concentration is discussed. (auth)

13409 WATER CONTAMINATION BY NUCLEAR RADIATION AND ITS PREVENTION. Hanns Mende (Firma Pintsch Bamag A. G., Butzbach/Hessen, Ger.). VDI Zeitschrift, 104: 115-19(Jan. 21, 1962). (In German)

Methods and equipment for the decontamination of water from nuclear power plants, nuclear research stations, hospitals, and industrial plants at reasonable costs are discussed along with methods and equipment for the prevention of water contamination. Where radioisotopes are used, a trap must be installed for collecting all waste water from the radioactive part of the building. Where radioisotopes of short half life periods are used, decay receptacles may be used. The easiest decontamination process consists of diluting the waste water. For radioactive materials, chemical decontamination and evaporation methods are suitable. (N.W.R.)

13410 PROTECTIVE MEASURES. Boris Rajewsky and Wolfgang Pohlit (Max-Planck-Institut für Biophysik, Frankfurt am Main). VDI Zeitschrift, 104: 185-8(Feb. 1, 1962). (In German)

The physical phenomena accompanying the origin of radioactive fall-out are reviewed. Information is presented on artificial radioactive substances in biocycles, hot particles, and air traffic problems. The review covers the progress made in this field of research over the past year. The bibliography contains 30 references. (N.W.R.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

Refer also to abstracts 13084 and 13192.

13411 (NP-11381) CONDITIONS D'UTILISATION DE LA SONDE A NEUTRONS POUR LES DETERMINATIONS D'HUMIDITE DANS LE SOL INFLUENCE DE LA DENSITE APPARENTE ET DE LA SALURE. (Conditions for Utilization of a Beam of Neutrons for the Determination of the Humidity of Soil. Influence of the Apparent Density and of Salt). J. Damagnez (Tunisia. Institut National de la Recherche Agronomique, Tunis). 1962. 11p.

For presentation at Colloquium on the Use of Radioisotopes and Research on Plant Nutrition by the Soil, Feb. 26–Mar. 2, 1962, Bombay.

A fast neutron source (e.g., the Ra–Be type) is lowered into the ground, and the ground-level thermal neutron intensity is measured using a BF_3 counter. The neutrons may be thermalized by collisions with H atoms (mostly in water), or they may be captured by Cl atoms in NaCl. The calibration of the neutron sonde, the effects of the physical parameters of the BF_3 counter on the linearity of the response, and the effects of the apparent density and NaCl content of the soil are studied. (T.F.H.)

13412 (NP-11416) MEASUREMENT OF DOSE DISTRIBUTION PRODUCED BY HIGH ENERGY ELECTRONS WHICH CAN BE APPLIED TO THE DOSE DISTRIBUTION CHARACTERISTICS OF THE ACCELERATORS UNDER A WIDE VARIETY OF CONDITIONS. Report No. 4 (Final), January 2, 1960–June 30, 1961. P. Y. Feng (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Contract DA19-129-qm-1526. 93p.

The distribution of radiation doses produced by high energy electrons in food or food-like systems is studied. Since such systems are as a rule heterogeneous in nature, efforts are devoted to a variety of heterogeneous systems. Electron irradiation experiments at energies of 1 to 17.5 Mev, for heterogeneous systems with a carbohydrate as the food-like phase plus various other materials (ranging from $Z \sim 6$ to 82), are carried out. A method of estimating the dose distribution in such systems based on theoretical principles is developed. Variations in the macroscopic radiation dose distributions in common irradiated food packages are found to usually be less than a few percent. Such variations are further reduced in flow or rotating systems. A theoretical study of the radiation dose distribution in gamma-irradiated heterogeneous systems is also carried out to establish the procedures needed for a study of the electron-irradiated systems. The study leads to a method of estimating the dose distribution in gamma-irradiated systems. (auth)

13413 (TID-6613(Suppl.2)) RADIOISOTOPES IN WORLD INDUSTRY. Abstracts of Selected Foreign Literature. (Division of Isotopes Development, AEC). Jan. 1962. 133p.

Abstracts are presented of 588 foreign technical publications reporting current progress in the use of radioisotopes in the physical and engineering sciences. With few exceptions, only abstracts of articles and publications in languages other than English are included. The abstracts are grouped by subject and subgrouped by country. Author and country indexes are appended. (C.H.)

13414 (AEC-tr-4492) TRANSACTIONS OF THE ALL-UNION SCIENTIFIC TECHNICAL CONFERENCE ON THE USE OF RADIOACTIVE AND STABLE ISOTOPES AND RADIATIONS IN THE NATIONAL ECONOMY AND IN SCIENCE, APRIL 4-12, 1957. MACHINE BUILDING AND INSTRUMENT MAKING. (Trudy Vsesoyuznoi Nauchno-Tekhnicheskoi Konferentsii po Primeneniyu Radioaktivnykh i Stabil'nykh Izotopov i Izluchenii v Narodnom Khozyaistve i Nauke, Aprel 4-12, 1957. Mashinostroenie i Priborostroenie). Translated from a publication of the Publishing House of the Academy of Sciences U.S.S.R., Moscow, 1958. 405p.

The 77 papers presented at the All-Union Scientific Technical Conference on the use of Radioactive and Stable Isotopes and Radiations in the National Economy and in Science, April 4 to 12, 1957, are given. Separate abstracts were prepared for each paper. (M.C.G.)

13415 (AEC-tr-4492(p.1-5)) THE APPLICATION OF RADIOACTIVE ISOTOPES IN MACHINE BUILDING. V. I. Dikushin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. I Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.3-7.

A discussion is presented of the following uses of radioisotopes in machine construction: as tracer atoms and as sources of radiation in the study of the reactions of substances in contact, their diffusion and solubility, and the durability of the parts of machines and instruments; in the testing and alteration of the properties of building, lubricating, and combustible materials; for the measurement and control of different parameters; and for the determination of the physical, chemical, and technological mechanisms of processes being automated. (M.C.G.)

13416 (AEC-tr-4492(p.6-15)) THE STRUCTURE AND DURABILITY OF CASE-HARDENED STEEL. L. S. Palatnik, I. M. Lyubarskii, A. P. Lyubchenko, and V. G. Nesterenko. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.8-15.

The mechanism of the formation of the durable structure of case-hardened alloy steel was studied using radioisotopes. A study of the radioactivity and an x-ray analysis of electrolytically separated carbides indicated that there are two relatively poor carbides in a case-hardened layer of 18 × HBA steel. The first is formed during cementation, while the second is formed in the process of cooling. During rapid cooling after cementation, noticeable breaking-down of the mosaic blocks did not occur in austenite, but a homogeneous microdeformation did take place. The breaking-down occurred only after a prolonged deterioration test. During slow cooling, breaking-down of the mosaic blocks and heterogeneous deformation arose immediately after thermal processing, even before operation of the machine part in friction. It was ascertained that different durabilities of steel can occur with the same phase composition. The resistance of steel to deterioration was determined by its fine structure. (M.C.G.)

13417 (AEC-tr-4492(p.16-19)) A STUDY OF THE DETERIORATION OF HIGH-STRENGTH CAST IRON. V. I. Stetsenko and E. A. Markovskii. Translated from Trudy Vsesoyuz. Nauch.-Teckh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.16-18.

Studies of the deterioration of high-strength cast iron were carried out with the aid of radioactive indicators. The samples were activated by the introduction of radioactive cobalt during the smelting process. The deterioration of the friction couples composed of high-strength cast iron of different structures was compared. The effects of velocity and load were determined. (M.C.G.)

13418 (AEC-tr-4492(p.20-7)) A STUDY OF THE BEHAVIOR OF A SULFIDED LAYER IN THE PROCESS OF DETERIORATION. V. E. Vainshtein and Yu. M. Vinogradov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.19-25.

The application of radioisotopes in the clarification of the mechanism of the deterioration of sulfided layers of cast iron during friction is discussed. Data were obtained with the aid of S^{35} on the nature of the distribution of sulfur throughout the interior, the regeneration of the sulfided layer in the process of the deterioration, and the transfer of sulfur to the adjacent friction surface. It was established that under various procedures of deterioration of the sulfided surfaces, sulfur was preserved on the friction surfaces even when the depth of the deteriorated layer exceeds the initial depth of sulfidization. It was assumed that the regeneration of the sulfided layer is a result of high temperature and deformation during friction of the contact areas, and that it presents a phenomenon of the diffusion type. (M.C.G.)

13419 (AEC-tr-4492(p.28-34)) A STUDY OF THE TRANSFER OF METALS DURING FRICTION AND DETERIORATION. G. M. Zamoruev (Zamoruyev) and Ya. N. Levin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.26-31.

The transfer of P^{32} from a donor to acceptor, depending on the type of deterioration, was studied. The results of the experiments confirmed the supposition that the transfer of material from one friction body to another and the intensity of this transfer do not have a direct relation to the intensity of disintegration. The relationship of the transfer of P^{32} to a number of external friction factors was investigated, and the possible paths of material transfer were reviewed. The depth of penetration of P^{32} and Fe^{59} in the acceptor during the deterioration of steel by means of a surface current was studied. It was observed that intense exchanges of material between adjoining bodies occur during friction and deterioration. The intense enrichment by P^{32} of the thin layer of lubricant, adsorbed on the acceptor's surface, was observed. (M.C.G.)

13420 (AEC-tr-4492(p.35-6)) THE PROBLEM OF THE TRANSFER OF METALS AND OF MATERIALS PRESENT ON THEIR SURFACES. G. V. Vinogradov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.32-3.

The possibility of the independent regeneration of a sulfided layer in the process of the deterioration of sulfided surfaces of cast iron is discussed. Four variations on the explanation of this process are given. It was concluded that the transfer of metal and of the components contained in it from one surface to another during friction is possible under small specific pressures. (M.C.G.)

13421 (AEC-tr-4492(p.37-9)) THE STUDY OF DETERIORATION DURING ROLLING FRICTION. V. P. Pavlov, G. V. Vinogradov, Yu. S. Zaslavskii, and F. B. Lebedev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostri. i Priborostr., p.34-5.

Research on deterioration during rolling friction was carried out on a specially constructed quadruple ball-bearing machine using radioactive indicators. The working elements in the machine are three standard steel balls toward which a ball, firmly attached by means of a nut to the shaft, presses down from above. Lower balls 8.7 mm in diameter and an upper ball 9.5 mm in diameter were used in the study. The balls were made of steel with a Rockwell hardness of 60 units. A curve of deterioration vs. length of machine operation was obtained. (M.C.G.)

13422 (AEC-tr-4492(p.40-7)) STUDY OF THE EFFECT OF THE QUALITY OF OIL UPON THE DETERIORATION OF CAST IRON. V. S. Zavel'skii and K. S. Ramaiya. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.36-42.

An apparatus was developed for the study of the effect of oil quality on the deterioration of cast iron and other metals and alloys using radioisotopes. The sensitivity of this method is such that deterioration may be determined within on the order of 0.005 micron. The amount of radioactive deterioration products accumulating in the oil was measured by gamma counting either on an oil sample taken through a cock or with the aid of a specially constructed pick-up filter. The antideterioration properties of fresh oils were studied, and the results are presented in curves. Tests were made on authentic M-20 engines to verify the results obtained. It was indicated that the antideterioration properties of oils for internal combustion engines can be determined correctly on the apparatus. Data showed that the initial effect of the accumulation of organic impurities in the oil during the engine's operation is to reduce deterioration. As they accumulate, however, they result in increased deterioration. A retardation of deterioration was observed in a gaseous environment. (M.C.G.)

13423 (AEC-tr-4492(p.48-52)) THE RELATIONSHIP BETWEEN THE DETERIORATION OF A DIESEL ENGINE'S UPPER PISTON RING AND CYLINDER BUSH AND THE ENGINE SPEED AND THE MAXIMUM PRESSURE OF THE CYCLE. M. D. Nikitin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.43-6.

Deterioration of an engine was studied using radioisotopes. Co^{60} was introduced into the molten metal from which the piston rings were cast. The activity was measured every hour on an oil sample of 400 g that was taken from the engine's crankcase. The relation of the deterioration of the piston rings and the cylinder bush to the speed of the diesel engine was determined. It was found that deteriorations decreased with a reduction in speed only if there was no loss of wheel lubricant. Increasing the maximum pressure in the cylinder led to an increase in the deterioration of the parts of the cylinder. (M.C.G.)

13424 (AEC-tr-4492(p.53-8)) A STUDY OF THE EFFECT OF DUST UPON THE DETERIORATION OF THE PARTS OF A TRACTOR MOTOR. A. I. Nisnevich. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.47-51.

Laboratory deterioration tests of various antifriction materials were carried out with natural, abrasive dust in the lubricant. The tests were conducted with the application of radioisotopes on a machine equipped with a continuous circulation system and an apparatus for determining the deterioration of the experimental parts of the basis of the amount of the radioactive deterioration products in the lubricant. The samples were actuated by introduction of Sb^{124} or Zn^{65} during the casting of the parts. Samples made from steel were irradiated with neutrons. The greatest deterioration of the alloys was caused by particles with average diameters of 30 to 40 microns. The maximum rapidity of deterioration was observed when the average diameter of the dust particles reached 10 to 20 microns. The rapidity of deterioration was also proportional to the amount of dust in the air drawn in the engine. (M.C.G.)

13425 (AEC-tr-4492(p.59-68)) THE REDUCTION OF THE LOW-TEMPERATURE DETERIORATION OF THE CYLINDER-PISTON GROUP IN ENGINES WITH THE USE OF OIL ADDITIVES. Yu. S. Zaslavskii, G. I. Shor, and I. A. Morozova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.52-60.

The reduction of the corrosive deterioration of the cylinder-piston group in engines at low temperatures of the cooling fluid by the introduction of special additives in the motor oils was studied using radioisotopes. The deterioration curves for cast iron in transformer oil and the effects of introduction of H_2SO_4 vapors are shown. It was concluded that electrochemical corrosion is the basic factor causing the deterioration of friction couples during their operation in an atmosphere of the vapors of acid solutions. It was found that protection of the friction surfaces from corrosive deterioration can be achieved by neutralization of strong corrosive acids, chemical reactions with the metal of the friction surfaces to form a firm protective coating on the metals' surface, and chemical reaction to form a protective coating from the products of the reaction with a simultaneous reduction of the friction coefficient. The most promising additives with neutralizing action were the lathers which are susceptible to hydrolysis in a water solution and which yield an alkaline reaction. (M.C.G.)

13426 (AEC-tr-4492(p.69-75)) A STUDY OF THE MECHANISM OF THE ACTION OF ANTICORROSIVE ADDITIVES TO OILS. Yu. S. Zaslavskii, S. E. Krein, R. N. Shneerova, and G. I. Shor. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.61-6.

The study of the formation of a protective coating on lead plates was carried out with some P^{32}-labeled, modified alkylphenol additives. The kinetics of the formation of the coating were determined by periodic recording with an end-window counter by the β-radiation on the surface of the plates. It was found that the sulfur- and phosphorus-containing compounds form a protective coating on the surface of the lead which hinders the corrosion of the metal. The protective effect of the coating was improved by the introduction of small amounts of organic acids into oil with an anticorrosion additive. It was concluded that it is advantageous to select those chemical compounds for improving the effectiveness of anticorrosion additives which would exert a polarizing action on the surface of the metal upon their introduction into the oil, but would not cause the destruction of the additives. (M.C.G.)

13427 (AEC-tr-4492(p.76-81)) A STUDY OF THE MECHANISM OF THE REACTION OF OIL ADDITIVES WITH METALS. M. M. Kusakov, G. V. Vinogradov, E. A. Razumovskaya, P. I. Sanin, and A. V. Ul'yanova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.67-72.

Results obtained during the study of the reaction of the naphthene–paraffin fraction of oil with additives of sulfur- and phosphorus-containing organic compounds labeled with S^{35} and P^{32} are presented. The studies were made on steel and copper at temperatures from 20 to 230°C. Results obtained during the study of the additives of elemental and organic sulfur compounds indicated that the greatest reactivity with the metals was observed for those organic sulfur compounds in which the sulfur atoms were active. In addition an active reaction with metals was observed at increased temperatures. It was found that phosphorus links far more easily than sulfur on the surface of steel. (M.C.G.)

13428 (AEC-tr-4492(p.82-7)) A STUDY OF THE DETERIORATION OF COGWHEELS IN COAL-MINING MACHINES. R. Ya. Studnits. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.73-7.

The application of radioisotopes in studying the deterioration of coal-mining machines is discussed. Radioactive deterioration products fall into the lubricant during tests, and the degree of deterioration of the cogwheel can be determined from the change in the oils' activity. Steel cogwheels with Zn^{65} tracer were used in the tests. The type of oil strongly influenced the deterioration. (M.C.G.)

13429 (AEC-tr-4492(p.88-91)) A STUDY OF THE DETERIORATION OF MEMBERS OF FEED UNITS IN AIRPLANE ENGINES. A. I. Yudin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.78-81.

Tracer techniques were used to study the deterioration of the band of needle bearings in airplane engines. The activation of the pivots and bearings being subjected to deterioration was accomplished with inserts. Eight holes were drilled in each pivot and bearing and radioactive inserts of a Co–Ni alloy containing Co^{60} were embedded in them. The amount of deterioration products was measured by directly recording the activity of the fuel coming from the unit. Graphs of the relation of the fuels' activity in pulses per minute to the time of the experiment on the load program were constructed. (M.C.G.)

13430 (AEC-tr-4492(p.92-5)) AN AUTOMOBILE ROAD LABORATORY FOR STUDYING THE EFFECT OF THE DUST CONTENT OF AIR AND THE QUALITY OF THE AIR PURIFIER ON THE DETERIORATION OF THE ENGINE'S PISTON RINGS. D. I. Vysotskii, G. I. Beloglazov, V. I. Golov, V. P. Kaznacheev, and Yu. G. Mochalov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.82-5.

A study of the effect of the dust content of air and the

quality of air purifiers on the abrasive deterioration of the automobile engine was carried out in an automobile laboratory. The deterioration of the piston rings was studied under road conditions. A groove was bored into the external surface of the piston rings and filled with Zn^{65}. The deterioration was measured on the basis of the radioactivity of the products accumulating in the filtering element. The effects of dust not filtered out by the air purifier on the deterioration of the piston rings were determined. (M.C.G.)

13431 (AEC-tr-4492(p.96-8)) AN APPARATUS FOR STUDYING THE FORMATION OF FILMS ON FRICTION SURFACES. M. Melik-Zade. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.86-8.

A method was developed for the processing of petroleum which permits observation, with the aid of radioisotopes, of the formation of coatings and the anticorrosive action of additives in the case of a pair of metallic surfaces in friction. A diagram and pictures of the apparatus are given. The kinetics of the formation of coatings on the friction surfaces were studied on the apparatus for the following metal couples: lead–copper alloy with steel, and steel with steel, in diesel oil with an additive labeled with S^{35}. Under the conditions of friction, coating formation had a tendency to stabilize. The thickness of the coat depended on the nature of the metals in friction. (M.C.G.)

13432 (AEC-tr-4492(p.99-103)) A SCINTILLATION APPARATUS FOR MEASURING THE RADIOACTIVITY OF FLUIDS. O. E. Kalinovskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.89-93.

An experimental apparatus with a scintillation counter was prepared for measuring the activity of the deterioration products in an oil sample. It gives stable readings. Its sensitivity is 7 times that of the apparatus with a Geiger-Mueller counter when the cosmic background is small. (M.C.G.)

13433 (AEC-tr-4492(p.104-11)) A STUDY OF THE METAL-CUTTING PROCESS. N. F. Kazakov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.94-100.

Studies of deterioration of cutting tools were carried out using the tracers Co^{60} and W^{187}. One hundred grams of shavings were removed from the metal part. The cutting time was varied depending on the test conditions. Micrometric and radioactive studies indicated the identical character of the changes in deterioration with cutting time. Minimum deterioration occurred at cutting speeds of 125 to 300 m. per min. It was ascertained that the transfer of the cutter's material can be reduced or increased depending on conditions, but it cannot be eliminated. (M.C.G.)

13434 (AEC-tr-4492(p.112-16)) STUDY OF THE DETERIORATION OF HARD ALLOY CUTTING TOOLS. B. D. Lazebnik. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.101-4.

Experiments for determining the relation of a tool's weighted deterioration per unit time to the cutting path were carried out with the help of radioisotopes. It was ascertained that the intensity of deterioration is quite high at the beginning of cutting, then it falls to a minimum, after which it gradually increases. This process is depicted in the form of two curves, an inverse hyperbola and a parabola. Formulas were developed for the rapid determination of the durability of a cutting tool depending on the cutting speed. (M.C.G.)

13435 (AEC-tr-4492(p.117-22)) STUDY OF THE DETERIORATION OF CUTTING TOOLS. G. M. Yakovlev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.105-7.

Experiments were carried out on the deterioration of a high speed steel plate and of hard alloys in friction with recently turned blanks of steel. The deterioration was studied by measurements of the activity of the surface layer. The cutter's deterioration had a sharply expressed, discrete character at all cutting speeds. The use of radioisotopes made it possible to study the mechanism of penetration of material from the processed surface to the cutting zone. A considerable reduction in the intensity of the transfer of the radioactive particles of material from one processed surface to another took place with an increase of the cutting speed. (M.C.G.)

13436 (AEC-tr-4492(p.123-6)) A METHOD OF EVALUATING THE CLEARNESS OF DECREASED METALS. R. B. Chernyakova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.108-11.

A method for controlling the quality of cleaning by aliphatic and lather emulsions was developed using radioisotopes. An 8% emulsion was used as the polluting agent on steel. Cs^{137}, in the form of a hydrochloride solution, was used as the indicator. Cleaning was done by boiling in an alkaline solution and then washing in first hot and then cold water. The amount of the polluting agent remaining on the sample after cleaning was determined on the basis of percentage activity. Autoradiography was used in studying the distribution of pollution on the surface of the sample. (M.C.G.)

13437 (AEC-tr-4492(p.127-34)) A STUDY OF THE PROCESSES OF SHAPING CASTINGS IN SAND MOLDS. B. B. Gulyaev, Yu. F. Borovskii, L. M. Postnov, and O. N. Magnitskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.112-18.

Radioactive indicators were used in studying the processes of the reaction of liquid metal with the sides of the sand mold in the initial and final stages of the solidification of castings. W^{185}, in the form of a water suspension of tungsten powder, was introduced into the molding sand to study the mechanism of formation of impurities. The effect of the bonding additives on the erosion of the molds' sides was evaluated on the basis of autoradiographs. Gating systems without a pit or with a deep pit in the foundation of the sprue were used. The amount of impurities in the metal castings was greater in the case of casting without a pit. (M.C.G.)

13438 (AEC-tr-4492(p.135-9)) A STUDY OF THE MECHANISM OF THE BASIC PROCESSES OF HOT TINPLATING. A. I. Vitkin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.119-23.

Experiments were performed to follow the movement of the particles of tin and iron in a flux-type working unit by means of tracer atoms in order to clarify the mechanism of

the hot tinplating process. Sn^{121} or Fe^{59} were introduced for this purpose into the molten bath or flux, depending on the phenomenon being studied. The studies indicated that the solution of iron in the flux ($Fe + 2H^+ \rightarrow Fe^{24} + H_2$) and its beneficiation by iron chlorides occurs when a steel tape is passed through the flux ($SnCl_2$) into the bath. At the same time, the tin of the liquid bath passes through the flux basically by means of solution according to the reaction $FeCl_2 + 3\,Sn \rightarrow FeSn_2 + SnCl_2$. In all cases the counter's readings revealed deposition of tin from the flux onto the sheet at a level higher than the level of the tin bath. (M.C.G.)

13439 (AEC-tr-4492(p.140-3)) THE UTILIZATION OF NUCLEAR RADIATION FOR THE MEASUREMENT OF THERMAL POWER PARAMETERS. G. G. Iordan and K. S. Furman. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.124-6.

Equipment for use of radiation for continuous and remote control of thermal power parameters is discussed and classified according to the principles of action. Uses of apparatus for measuring the level, density, consistency, thickness, concentration, water content, and temperature are described. (M.C.G.)

13440 (AEC-tr-4492(p.144-51)) THE REDUCTION OF ERRORS DURING MEASUREMENTS WITH SCINTILLATION COUNTERS. B. I. Verkhovskii, V. A. Sotnikov, and V. V. Yakushin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.127-33.

A method was developed for reducing the errors introduced in measurements with scintillation counters by instabilities in the units. A simplified circuit diagram for one variation of the method is given. The measured and standard radiation fluxes fall on the phosphor of the scintillation counter. The phosphor is placed in a lead jacket with two openings through which the radiation penetrates. Within the jacket there is a rotating lead cylinder. First the measured and then the standard radiation flux falls on the phosphor during the rotation of the cylinder. If they are not equal in magnitude, the mean velocity of the pulse from the photomultiplier to the cathode follower and amplifier is modulated by the frequency of the radiation fluxes. Experimental verification of the method was carried out for cases of gamma and luminous fluxes. (M.C.G.)

13441 (AEC-tr-4492(p.152-8)) METHOD OF ANALYSIS WITH THE AID OF RADIATION. V. A. Korotkova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.134-9.

Uses of radiation in analyzing the composition of materials are discussed. The method of activation analysis is outlined and its effectiveness is considered. (M.C.G.)

13442 (AEC-tr-4492(p.159-65)) AUTOMATION OF THE MEASUREMENT AND RECORDING OF THE INTENSITY OF ATOMIC RADIATION. V. N. Afanas'ev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.140-5.

A system for measuring and recording radiation intensity is described. The simplicity of the circuit, which operates on the basis of the time-dependent method, is guaranteed by the fact that the state of only one cell need be fixed, as well as the fact that it is easy to record the time interval on the recording apparatus. The range of intensities measured, greatest time of measurement, recording error, and resolving power of the counter channel are discussed. (M.C.G.)

13443 (AEC-tr-4492(p.166-9)) A STUDY OF THE ELECTRICAL PROPERTIES OF IONIZATION RESISTORS. V. G. Telichkin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.147-9.

Since the dimensions of ionization resistors must be small, the maximum degree of ionization is guaranteed by soft α and β radiation. The following isotopes are recommended for use: Pu^{238}, Po^{209}, Pu^{239} (with a large Pu^{240} content), C^{14}, Th^{229}, and U (with a large U^{232} content). It was ascertained that the following factors influence the magnitude of the voltage coefficient: the distance between the electrodes, the composition of the gas, the configuration and strength of the electrical field, and the ionization per unit volume. The resistor's temperature coefficient is determined by the composition of the gas and the pressure in the ionization chamber. (M.C.G.)

13444 (AEC-tr-4492(p.170-2)) THE USE OF RADIOACTIVE ISOTOPES FOR THE AUTOMATION OF MINING AND SINKING MACHINES. V. G. Segalin and A. A. Rudanovskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.150-2.

The automatic stabilization of the movement of mining and sinking machines according to a given program and in conformity with the hypsometry of the bed using the peculiarities of the reactions of radiation with the ground, rock, and coal is described. It is possible to use either scattered gamma radiation or induced activity in this method. The automatic stabilization of coal combines under conditions of the latent contact of the coal-bearing rock in which the width of the block can attain several centimeters is discussed. (M.C.G.)

13445 (AEC-tr-4492(p.173-8)) MEASUREMENT OF FLUID DENSITY WITH THE AID OF GAMMA RADIATION. G. G. Iordan and K. S. Furman. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.153-8.

The measurement of fluid density using gamma radiation from radioisotopes is discussed. An apparatus was developed for continuous remote measurement, recording, and regulation of fluid density using radiation. The circuit diagram is shown. The utilization of the principle of automatic compensation permitted considerable reduction in the effect on the precision of the apparatus of changes in radiation intensity and the amplification factor. (M.C.G.)

13446 (AEC-tr-4492(p.179-85)) A NEW TYPE OF RADIOACTIVE DENSIMETER. G. I. Birger, B. I. Verkhovskii, and E. Ya. Ovcharenko. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.159-64.

An apparatus was developed for determining the sizes of particles suspended in pulp for the maximum extraction of minerals in the ore flotation concentration process. The apparatus is based on the utilization of gamma radiation. Calculations indicated that, in the measurement of the pulp density with an error of 1 to 1.5%, it is possible to avoid errors introduced in the determination of the pulp density

by changes of the mineral composition, by utilizing sufficiently hard gamma radiation. The compensation method of measurement was used to reduce errors due to scintillation counter inadequacies. (M.C.G.)

13447 (AEC-tr-4492(p.186-95)) INDUSTRIAL APPARATUS FOR THE CONTROL OF DENSITY BY MEANS OF GAMMA RAYS. E. G. Kardash. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.165-73).

Methods of density control based on the measurement of the absorption of gamma rays by the material are outlined. A gamma densimeter for a dredging apparatus was developed for the continuous remote measurement of the percentage content of soil in a mixture of soil and water passing through a soil pipe. The densimeter consists of an emitter and a radiation detector, installed directly on the pipe through which the control mixture passes, and an amplifier-transformer apparatus. Several variations of the design are described. The performances of the radiometric densitometers are evaluated. (M.C.G.)

13448 (AEC-tr-4492(p.196-204)) CALCULATION AND STUDY OF THE DENSITY OF IRON ORE PULP ON THE BASIS OF GAMMA-RAY ABSORPTION. A. K. Val'ter and M. L. Gol'din. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.174-81.

The calculation of the density of iron ore pulp on the basis of gamma absorption is discussed. The linear absorption factor for gamma absorption by the pulp was determined. Expressions were obtained for the absolute and relative errors of measurement of the pulp density. The optimal magnitude of activity was computed. Co^{60}, Cs^{134}, and Cs^{137} were selected as the most suitable isotopes. The pulp density was calculated on the basis of gamma absorption. The accuracy of the computation method was within 5% as was confirmed by experiments conducted on iron ore pulp. (M.C.G.)

13449 (AEC-tr-4492(p.205-6)) PROBLEMS OF GAMMA-RAY PULP-MEASURING DEVICES IN DREDGING APPARATUS. G. B. Vishnyak. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.182-3.

Defects in gamma pulp-measuring devices installed in 1955 are discussed. The zero position of the apparatus was unstable and required frequent adjustment. Stabilization of the voltage was quite inadequate and even small fluctuations in the power supply caused incorrect readings. The tubes failed often and their contacts were weakened by vibrations. (M.C.G.)

13450 (AEC-tr-4492(p.207-13)) EXPERIENCE IN UTILIZING A GAMMA-RAY DENSIMETER DEVELOPED BY THE LENINGRAD PHYSICAL-TECHNICAL INSTITUTE, ACADEMY OF SCIENCES USSR. E. M. Lobanov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.184-9.

A noncontact gamma densitometer was developed for the continuous control of the density of pulp in the pulp ducts of dredging machines. The following compensation method of measurement was used in the circuit: the electrical signal, coming from the counters at the input of the measured circuit when the pulp duct is filled with pure water, is compensated by unbalancing a vacuum-tube voltmeter. Tests run on the instrument are described. It was determined that pulp density can be measured with an accuracy of ± 1.2% by this method. (M.C.G.)

13451 (AEC-tr-4492(p.214-16)) THE APPLICATION OF RADIATION IN INLAND WATER TRANSPORTATION. S. N. Dedyukov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., p.190-1.

A program for the utilization of radioisotopes and radiation in inland water transport was developed and is being put into practice. More than 30 gamma soil meters were used in the operation on the dredging machines resulting in an increased productivity of 10 to 15%. An instrument for measuring the thickness of ship hulls and various articles of sheet material was developed. A level gage using radioisotopes was used to control water levels on a ship canal. A ship dynamotor with a beta photo-primary element was also developed. The compilation of an album of standard gamma photographs of welded seams was completed. (M.C.G.)

13452 (AEC-tr-4492(p.217-20)) THE USE OF RADIATION FOR THE AUTOMATIC CONTROL AND REGULATION OF TECHNOLOGICAL PROCESSES IN THE PRODUCTION OF DAIRY PRODUCTS. A. Ya. Vainberg. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957(1958). Mashinostr. i Priborostr., 192-5.

Instruments using radioisotopes were developed for determination and control of the amount of dry substances in evaporated milk with sugar. Comparative measurements were made using these methods and the laboratory method of drying to a constant weight. The results indicated that the discrepancies do not exceed ± 1%. (M.C.G.)

13453 (AEC-tr-4492(p.221-8)) THE APPLICATION OF RADIOACTIVE ISOTOPES IN THE LEATHER INDUSTRY. S. M. Smirnov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.196-202.

The use of radioisotopes in measuring the thickness of raw leather is discussed. The accuracy of thickness evaluations by means of the absorption of radiation was found to be approximately 5%. This can be raised by the introduction of a seasonal adjustment in the calculated value of the raw hide's humidity. The measuring diapason of the thickness gages must be 0.2 to 0.6 g/cm^2 for hides. Radioisotopes passing hard β radiation, including the following, are suitable for this diapason: Sr^{90}, Cs^{144}, and Ru^{106}. Halogen counters operating at a mean current were used as the receiver. The electrical circuits are described. Design variations are discussed. (M.C.G.)

13454 (AEC-tr-4492(p.229-32)) A RADIOMETRIC METHOD OF DETERMINING THE DENSITY OF THE HAIR COVERING OF FUR PELTS. V. A. Pchelin and T. A. Shmeleva. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.203-5.

A radiometric method was developed for a rapid and objective quantitative evaluation of the density of the hair covering of a fur pelt without damaging it. The apparatus is described and diagrams given. Before beginning the measurements of the density of the fur pelts' hair covering, the iron shaft of the supporting attachment is placed 2 mm below the emitter, in order to eliminate the absorp-

tion of radiation by the skin tissue of the pelt. The densimeter was used to study the thickness of hair covering with respect to the topography of the pelts of a rabbit and a sheep as well as for studying the changes occurring during processing. (M.C.G.)

13455 (AEC-tr-4492(p.233-9)) THE USE OF RADIOACTIVE ISOTOPES IN THE TEXTILE INDUSTRY. S. S. Shvyrev, A. N. Slatinskii, and K. D. Pismannik. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.206-11.

The methods of controlling the weight and irregularity of textile materials by means of the degree of radiation attenuation are discussed. An apparatus was developed of the measurement and recording of the irregularity of the products of the spinning industry. The isotope Tl^{204} was used as the source of radiation. Use of the apparatus permitted the time needed for the control of the irregularity of products by the existing methods to be reduced approximately 12 times. An apparatus using Tl^{204} as a radiation source was also developed for the continuous measurement of the weight of materials deposited on the fabric in the process of the manufacture of oilcloth and leatherette. Tests indicated that the error of the apparatus does not exceed ±1% under industrial conditions. A simplified circuit diagram of one of the systems developed for the automatic regulation of the count of canvass on a beating machine which utilizes a radioactive primary element is shown. (M.C.G.)

13456 (AEC-tr-4492(p.240-5)) THE USE OF RADIOACTIVE ISOTOPES FOR CONTROLLING THE WEIGHT OF PAPER SHEETS. E. A. Nekhaevskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.212-16.

The absorption of beta radiation by the material being controlled was utilized for controlling the density of paper and cardboard. The constancy of the geometric factors is substantially reflected in the beta apparatus. The movement of a lamellar absorbent in the working space causes a change of the readings and introduces an error of up to 15%. An experimental curve of the ratio of the error to the position of the absorbent for paper weighing 137 g/m^2 is given. A radiation source, deposited on a cylindrical surface, was used in the apparatus. The apparatus must detect a change of paper weight of 0.001 part of the total mass of all the absorbents. An instrument using beta radiation was developed for continuous and noncontact control of the density of a moving paper band. (M.C.G.)

13457 (AEC-tr-4492(p.246-53)) A SCINTILLATION THICKNESS GAUGE FOR PIPES. E. G. Kardash. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Isotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.217-22.

A thickness gage for pipes utilizing a scintillation counter as the radiation detector was developed. The gage permits measurements of nonuniformity in pipe thickness, as well as measurements of the thickness of pipe walls and convex reservoirs. In addition to its high accuracy, the apparatus is characterized by its high stability. The advantages of the application of isotopes with soft radiation are discussed. (M.C.G.)

13458 (AEC-tr-4492(p.254-8)) MEASUREMENT OF THE CONCENTRATION OF SOLUTIONS BY MEANS OF BETA RADIATION. G. G. Iordan and T. G. Neiman. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.223-6.

Methods of determining concentration, based on the utilization of the laws of absorption and scattering of the beta radiation of radioisotopes in the substance, were developed to provide automatic control of the technological processes. Design and construction of an apparatus for use of these methods are described. A typical curve of the ratio of the current created in the ionization chamber by the reflected beta particles to the atomic number of the reflector's material is presented. Tl^{204}, Sr^{90}, and Ru^{106} were chosen as the most convenient sources of radiation. The sensitivity of the method was studied. (M.C.G.)

13459 (AEC-tr-4492(p.259-66)) THE UTILIZATION OF THE BACKSCATTERING OF BETA RADIATION FOR THE CONTROL OF THE THICKNESS OF COATINGS. B. I. Ermolaev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.227-33.

The chief results of a study of the backscattering of β radiation which permits an apparatus to be developed for the control of the thickness of coatings, in which the properties of the phenomenon are used efficiently, are given. The relation of the ionization current to the type of reflector and the thickness of the filter was determined. The ratio of the intensity of backscattered radiation to the thickness of a coating was found and curves were developed. It was ascertained that a change in the purity of processing and the curvature of the parts' surface, while changing the absolute value of the intensity of backscattered radiation, does not effect the trend of the curve. The method of calibrating and adjusting the apparatus is described. Errors of measurement, sensitivity, and limits of measurement are discussed. The apparatus developed for controlling the thickness of a coating is described. (M.C.G.)

13460 (AEC-tr-4492(p.267-8)) AN APPARATUS FOR MEASURING THE THICKNESS OF COATINGS. N. V. Yur'ev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.234-5.

An apparatus was developed which utilizes backscattering of beta radiation to measure the thickness of coatings of thin layers of various materials on a flat object with a coarsely processed surface. The equipment of a serial amplifier was an emitter with an ionization chamber screwed onto the head of the amplifier's input unit. (M.C.G.)

13461 (AEC-tr-4492(p.269-73)) EXPERIENCE OF INTRODUCING APPARATUSES FOR MEASURING THE THICKNESS OF ROLLED IRON AND COATINGS. L. N. Baskin, A. M. Bogachev, L. A. Brodskii, B. I. Verkhovskii, A N. Makarov, N. S. Novoshenya, and L. A. Rubinshtein. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.236-9.

Apparatuses using gamma radiation from Ir^{192} for measuring the thickness of a cold rolled strip from 30 μ to 1 mm thick were improved. Increased protection was given the radiation source from possible damage in the event of a break of the rolled strip. The zero drift of the electromagnetic vibrator was reduced to ±1 mv. In the perfected device only the radiation source is placed near the strip being measured while the ionization chamber is set at a distance

of 1000 mm from the strip being controlled. Such an arrangement reduced by several times the error of the determination of the thickness arising as a result of the vertical fluctuations of the strip being measured. (M.C.G.)

13462 (AEC-tr-4492(p.274)) THE UTILIZATION OF THICKNESS GAUGES AT THE "ZAPOROZHSTAL" PLANT. N. S. Novoshenya. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.240.

The use of isotope thickness gages at the cold rolling mills and the sheet iron shop of the zaporozhstal plant permitted the flow of metal due to non-uniformity to be cut in half. Satisfactory gages for hot rolled strip were not found. Safety in the use of these isotope gages is discussed. (M.C.G.)

13463 (AEC-tr-4492(p.275-81)) A CALCULATION OF THE STATISTICS OF THE CONTROL SIGNAL IN RECORDING RADIOACTIVE RADIATION BY RELAY TYPE APPARATUSES. I. M. Taksar and V. A. Yanushkovskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.241-6.

Analysis of the operation of a radioactive relay, operating under conditions of recording the mean current or pulse moding without a pulse calibrator in the counting rate meter, is described. The use of Campbell's theorem is explained. The process of the increase of voltage on the integrating capacitor in the circuit and the process of the change in voltage in the time interval between K and K + 1 pulses were examined. Equations were derived. Block diagrams for experimental verification of the formulas are included. (M.C.G.)

13464 (AEC-tr-4492(p.282-8)) SEVERAL PROBLEMS CONCERNING THE DESIGN OF GAMMA-LEVEL GAUGES. V. K. Latyshev, V. V. Lyndin, S. V. Medvedev, Yu. S. Pliskin, L. K, Tatochenko, and V. I. Shul'ga. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.247-51.

Circuits and designs of several level gages using gamma radiation are described. A substantial simplification of the circuits and a reduction of cost from that of previous modes was achieved by utilization of gas counters in a mean current mode of operation. The gamma gages can be divided into three types: follow-up systems, the intensimeter type, and the relay type. The operation of each is discussed. (M.C.G.)

13465 (AEC-tr-4492(p.289-91)) THE USE OF SCINTILLATION COUNTERS WITH ELECTRONIC MODULATION FOR RECORDING GAMMA-RADIATION. E. Ya. Ovcharenko. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.252-4.

A device for the recording of gamma radiation with a scintillation counter and an amplifier on semiconductor triodes was developed. Several methods of electronic modulation were tested. The possibility of carrying out an electronic modulation in the photomultiplier by means of a pulsating voltage was proved. (M.C.G.)

13466 (AEC-tr-4492(p.292-5)) PORTABLE RADIOACTIVE LEVEL INDICATORS. K. K. Shpor and V. A. Yanushkovskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.255-7.

A float with a gamma source can be used for measuring the level of the fluid in large closed vessels. The position of the float can be determined by detection of the radiation penetrating the walls of the container. Three modifications of the level indicator's design are described. (M.C.G.)

13467 (AEC-tr-4492(p.296-7)) A DEVICE FOR MEASURING THE LEVEL OF POWDERED MATERIAL. E. A. Brik. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.258.

A device for indicating the level of the following powdered material was developed: crushed chalk, talc, kaolin, and soot. All the level gases in a particular ship derive their power from a stabilized power unit. A Co^{60} emitter was used. (M.C.G.)

13468 (AEC-tr-4492(p.298-303)) RADIOACTIVE RELAY DEVICES FRO AUTOMATION AND CONTROL. Ya. A. Auzan, V. E. Banashek, Kh. E. Gunne, I. M. Taksar, A. D. Tumul'kan, P. F. Chaplinskii, I. A. Eimanis, and V. A. Yanushkovskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.259-63.

Electronic circuits which record radiation on the basis of the yes-no principle and their uses are discussed. A standard circuit of the radioactive relay supplied with an a-c current, which is used as a reference input element of the position control of the power voltage, is shown. The utilization of a noncontact radioactive relay on a gas discharge counter simplifies the electrical circuit in comparison with other radiation detectors. Uses in radioactive control thermometers, position controller of fluid density, control of filling nontransparent vessels and automatic switching from one motion picture projector to another are described. (M.C.G.)

13469 (AEC-tr-4492(p.304-5)) A GAMMA RELAY IN TRANSISTORS. V. G. Segalin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.264-5.

A gamma relay on transistors possesses the following advantages over an apparatus on electron tubes: increased life span and development in the form of a detachable unit. The main features of the circuit are described. (M.C.G.)

13470 (AEC-tr-4492(p.306)) AN EVALUATION OF THE LOAD MINIMALLY NECESSARY FOR COUNTERS IN A GAMMA-RELAY. K. S. Klempner. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Isotopov i Izluchenii v Narod. Khoz. i Naube, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.266.

The evaluation of the gamma relay counter load that is minimally necessary at a specified quick starting time is discussed. (M.C.G.)

13471 (AEC-tr-4492(p.307-10)) THE UTILIZATION OF RADIOACTIVE ISOTOPES FOR THE AUTOMATIC CONTROL OF THE RATE OF FLOW OF FLUIDS. N. N. Shumilovskii, Yu. V. Gushchin, and M. I. Tolokonnikov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.267-70.

A method of measuring the rate of flow of liquid currents,

based on the utilization of the mechanical modulation of radiation, was developed. A vane is put in the stream of the liquid. A radioisotope is placed in one or more blades of the vane so that its contact with the fluid being measured is avoided. Gas discharge counters measure the radiation. The receiver records a packet of gamma quanta during each rotation of the vane. The frequency of the packets depends on the speed of the vane's rotation which is proportional to the liquids rate of flow. The maximum error in measurement was found to be ±2.5%. (M.C.G.)

13472 (AEC-tr-4492(p.311-16)) THE USE OF SHORT LIVED ISOTOPES FOR CONTROLLING THE TECHNOLOGY OF THE PRODUCTION OF STEEL TAPE. V. V. Kryzhanovskii, I. I. Safyants, and V. A. Yanushkovskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.271-5.

The radioactive method of marking metal for controlling the technological process of the production of cold-rolled steel tape is described. The basic factor which determined the selection of P^{32} as the radiation source in marking steel tape was the requirement for carrying out the marking procedure during processing and cessation of the metal's radioactivity when the finished product leaves the warehouse. The need for recording the radioactive markers when the steel tape is moved relative to the gas discharge counters is a feature of the determination of the marking code in the production of the steel tape. Preparation of the radioactive electrode using P^{32} is described. Marking was carried out at the 6/160 corrugating and rolling mills. (M.C.G.)

13473 (AEC-tr-4492(p.317-21)) THE USE OF RADIOACTIVE RADIATION FOR THE NONCONTACT CONTROL OF A GAS STREAM'S RATE OF FLOW AND VELOCITY. N. N. Shumilovskii and L. V. Mel'ttser. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.276-9.

A noncontact method of controlling the rate of flow and velocity of a gas, based on the utilization of modulated radiation, was developed. The radioisotope is placed in a container outside the pipe. The radiation directed onto the pipe is interrupted by a special modulator device. By this method ionized segments of the stream, "pockets," are formed and transported with the gas stream. A receiver located lower along the stream fixes the moment of the ion pockets' arrival, and a special measuring device computes the time between the pockets' formation and its passage by the receiver. The modulator is a mechanical or magnetic radiation chopper. The receiver consists of two isolated plates which create a transverse electric field in the pipe. Beta radiation was considered the most suitable for this device. (M.C.G.)

13474 (AEC-tr-4492(p.322-8)) THE USE OF ALPHA EMITTERS FOR MEASURING GAS DENSITY. Ya. Yu. Rebo and D. N. Ziv. Translated from Trudy Vsesoyuz. Nauch., Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.280-5.

Problems connected with the development of α-ionization devices, intended for use in the measurement of gas density, are discussed. The sensitive element of these devices is an ionization chamber. Two types of devices for measuring air density, based on the α-ionization method and intended for measuring pressures ranging from 10 to 1000 mm Hg, are described. The basic principles involved in the calculation and planning of an ionization chamber with an emitter were examined. (M.C.G.)

13475 (AEC-tr-4492(p.329-32)) AN APPARATUS FOR THE AUTOMATIC CONTROL OF A GAS'S RATE OF FLOW UTILIZING BETA RADIATION. G. G. Iordan, K. S. Furman, and T. G. Neiman. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.286-8.

A radioactive flowmeter for use in the continuous remote measurement, recording, and control of the rate of flow of various gases, without a loss of pressure in the stream, was developed. A β radiation flux passes through the wall of the pipe and forms ion packets in the gas which are carried away by the gas stream to the side of the receiver. The electric signals produced by the receiver at the moment of the ion packets' passage alongside it arrive at the input of the preamplifier. They are subsequently transmitted along a cable to an electronic transformer. The signals from the preamplifier formed at the moment of the ion packets' passage alongside the receiver shift the trigger of the transformer to one of its two stable positions. The signals generated by the modulator at the moment of the start-up of the ion packets also arrive at the transformer and shift the trigger to the other stable position in which it remains until the reception of signals from the preamplifier. (M.C.G.)

13476 (AEC-tr-4492(p.333-6)) THE UTILIZATION OF RADIOACTIVE ISOTOPES FOR REMOVING CHARGES OF STATIC ELECTRICITY IN THE SILK INDUSTRY. P. A. Polonik, L. V. Mel'ttser, and N. I. Panyukov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.289-91.

The neutralization of charges of static electricity formed on silks and synthetic fibers during their processing was studied. The use of radiation for this was investigated. Experiments were carried out under industrial conditions on warp machines in which intensive electrification forms, resulting in increased damage, and it does not permit the speed of the machine's operation to be very high. The isotopes Pu^{239} and S^{35} were used. The study that was carried out indicated that with the installation of an S^{35} emitter with an activity of 300 μc on a warp machine, the speed could be increased from 80 to 220 m/min. (M.C.G.)

13477 (AEC-tr-4492(p.337)) SOME PROBLEMS OF THE PREPARATION OF BETA EMITTERS FOR THE REMOVAL OF AN ELECTROSTATIC CHARGE. A. N. Vedernikov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.292.

The preparation of S^{35} sources for the removal of electrostatic charges from fibers is described. The sources were oxide films incorporating S^{35} on Al or its alloys, prepared by oxidizing the metals in labeled H_2SO_4. (M.C.G.)

13478 (AEC-tr-4492(p.338-42)) THE UTILIZATION OF RADIOACTIVE ISOTOPES IN SAFETY TECHNIQUES. V. S. Medvedeva and I. S. Roizen. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.293-7.

Work on the utilization of radioisotopes is being carried out along two lines: neutralization of charges of static electricity and development of an emergency switch for rollers. Experimental data indicated that the greatest effectiveness

of air ionization and consequently the greatest neutralizing capacity are possessed by α emitters at a distance of 30 to 40 mm. With the use of Po^{210} or Pu^{239}, these emitters are capable of neutralizing a static electricity potential of an order of 50 to 80 thousand watts at a distance of 3 to 6 cm. If there is no opportunity of placing the neutralizer near the charged material, it is necessary to use β emitters, since β particles possess a considerably larger range in air than α particles. The use of β emitters for volume ionization of apparatus or premises is being studied. Several shut-off circuits for rollers based on the action of a radioactive bracelet were developed and tested. Sr^{90} was the isotope used. (M.C.G.)

13479 (AEC-tr-4492(p.343)) ON THE PRODUCTION OF PLATES FOR THE NEUTRALIZATION OF CHARGES. I. S. Roizen. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.298.

Methods for the production of radioactive plates for the neutralization of charges of static electricity are discussed. (M.C.G.)

13480 (AEC-tr-4492(p.344-5)) THE DETERMINATION OF THE SITE OF LEAKAGE IN THE LEAD SHEATHING OF A COMMUNICATION CABLE. T. V. Abramova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.299-300.

An effective method was developed for the determination of the site of damage of a communication cable's lead sheathing by means of radioactive gases, radon and labeled methyl bromide. It was determined that the two gases diffuse to the surface from a depth of 0.8 to 1.5 m within 1 to 2 hr in clay, sand, chernozem, loam and sandy loam both in summer and in winter. The radioactive gas introduced into the cable in a jet under pressure at a distance of 500 to 2000 m from the assumed site of damage is observed by field type radiometers 2 to 3 hr later on the surface of the ground over the site of the damage. (M.C.G.)

13481 (AEC-tr-4492(p.346-9)) DETERMINATION OF THE SITE OF GAS LEAKAGE FROM UNDERGROUND GAS MAINS. V. I. Kuznetsov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.301-3.

The use of radioisotopes for detecting gas leakage in underground gas mains was investigated. Br^{82}, which was introduced into the gas fuel in the form of the compound CH_3Br^{82}, was used in the study. Two mains were used: one 50 m long and with a diameter of 100 mm, the other 56 m long and with a diameter of 125 mm. Openings 2 to 3 mm wide were made in both. One gas main was covered with sand and the other with clay and sand. The results indicated that the gas' maximum activity was over the site of its leakage. The activity was also greater over the site of damage in the main covered with sand than the other. (M.C.G.)

13482 (AEC-tr-4492(p.350-6)) THE IONIZATION METHOD OF GAMMASCOPY. L. K. Tatochenko. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.304-9.

The method of gammascopy utilizing radiation intensity indicators is discussed. The method of calculating the parameters of ionization gammascopes for various purposes was examined. Their use in control of castings of great thickness and of welded seams in articles of small thickness is described. (M.C.G.)

13483 (AEC-tr-4492(p.357-61)) THE USE OF SCINTILLATION COUNTERS IN BETATRON GAMMASCOPY. I. G. Fakidov, A. A. Samokhvalov, N. I. Davidenko and M. D. Avramenko. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Pribrostr., p.310-13.

Work on the use of counters for gammascopy is described. Scintillation counters were used for the development of a more productive method of betatron gammascopy. A gamma defectoscope for the irradiation of steel possessing great thickness was developed. A gammascope with a scintillation counter consists of a radiation source, a mechanical device for the movement of the articles being tested, and a recording element. A naphthalene phosphor yielded satisfactory results. The experiments indicated that a gammascope with a differential scintillation counter detects an increase of thickness of approximately 0.5%. (M.C.G.)

13484 (AEC-tr-4492(p.362-8)) THE USE OF A SCINTILLATION COUNTER FOR THE QUALITY CONTROL OF MANUFACTURED ARTICLES. A. A. Arkhangelskii and G. D. Latyshev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.314-19.

The pulse-counting method of gammascopy involving the use of a device which analyzes the pulse according to height and the method of measuring the current at the outlet of a photomultiplier are reviewed. A gammascope using these methods is described. Circuit diagrams are shown. The sensitivity was found to be such that grooves 0.25% of the sample's thickness could be distinguished. Automation of gammascopy is discussed. (M.C.G.)

13485 (AEC-tr-4492(p.369-73)) THE CONTROL OF WELDED SEAMS BY THE IRRADIATION METHOD IN FERROUS METALLURGY. L. K. Tatochenko, V. S. Tokmakov, and V. K. Latyshev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.320-3.

The use of gamma radiation for quality control of welded seams is discussed. The method of gammascopy was used for the control of the welded seams of the bottoms of steel teaming ladles, boilers, pipes, and other structures. The design and principles of operation of the ionization gammascope are discussed. The indicator and recording units are described. (M.C.G.)

13486 (AEC-tr-4492(p.374-8)) THE RADIOGRAPHY OF THE BUTT WELDS OF PIPES. S. T. Nazarov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.324-8.

Many butt joints of pipes possessing a diameter of 57, 100, and 182 mm and a wall thickness ranging from 3.5 to 12.5 mm were irradiated with gamma rays of the isotopes Co^{60}, Cs^{137}, and $Eu^{152-154}$ for the purpose of studying the purpose of studying the possibility of the detection of the defects of butt welds. The possibility of detecting a spill in the butt welds of pipes was preliminarily studied by means of geometric calculations. The sensitivity to the detection of the minimum defect by gamma rays of Eu was the highest for all pipe diameters. The minimum defect detected varied from 1.5 to 2% of the total thickness of the

pipe. A special device was developed for the control of the butt welds of pipes under field conditions. (M.C.G.)

13487 (AEC-tr-4492(p.379-84)) GAMMASCOPY OF THIN-WALLED PARTS BY MEANS OF THE UTILIZATION OF THE ISOTOPE Tu^{170}. S. V. Rumyantsev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.329-33.

The use of radioisotopes for controlling steel parts with a thickness of less than 15 mm is discussed. The defectoscopic properties of preparations of Tm^{170} possessing a differential activity were studied. Tests indicated that the use of Tm^{170} sharply increased the sensitivity of the gammascopy method on the irradiation of steel possessing a thickness of up to 15 mm, in comparison with other isotopes. The best detection was achieved in the case of the use of radioactive preparations of smaller geometric dimensions. (M.C.G.)

13488 (AEC-tr-4492(p.385-9)) GAMMASCOPY OF STEEL ARTICLES POSSESSING GREAT THICKNESS. I. G. Fakidov and A. E. Buzynov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.334-8.

The use of radiation created by a betatron for quality control of steel articles of great thickness is discussed. The advantages of this betatron radiation compared with gamma and x rays are listed. The possibility of the application of the radiation of a 22 Mev betatron for purposes of defectoscopy was studied. The sensitivity of the x-ray film was determined. (M.C.G.)

13489 (AEC-tr-4492(p.390-2)) FEATURES OF THE GAMMA CONTROL AND IRRADIATION TECHNIQUE OF COMPLEX WELDED JOINTS. K. M. Grigorev (Grigoryev) and I. G. Fakidov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.339-41.

In welded joints of great thickness, the method of gammascopy acquires features which depend on the type of welded joint, the method of welding, the thickness of the metal, and the nature of the defects. Irradiations in 4 different positions are sometimes necessary. Several methods of irradiation are described, and the applications of each are discussed. (M.C.G.)

13490 (AEC-tr-4492(p.393-8)) STUDY OF BLURRING OF THE IMAGE OF DEFECTS DURING THE IRRADIATION OF STEEL WITH GAMMA RAYS OF THE ISOTOPE Co^{60}. N. P. Grazhdankina and I. G. Fakidov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.342-7.

The portion of blurring of the images of defects in gamma radiography which is caused by the internal poorly defined nature of the film and the screens, as well as the scattered radiation was determined. The difference in the general magnitude of the blurring area and the blurring caused by the geometry of the experiment was measured, and the effects of various experimental conditions were analyzed. The inner blurring determined by the film itself was equal to 22%, 17% of the blurring was due to scattered radiation, 11% to the light of the fluorescent screens, and 5% to the inner poorly defined nature of the film. (M.C.G.)

13491 (AEC-tr-4492(p.399-402)) THE USE OF SOFT RADIATION ISOTOPES FOR THE CONTROL OF WELDING IN SHIPBUILDING. O. N. Zhukov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., 348-51.

The use of the isotopes Se^{75}, Ir^{192}, Cs^{137}, and $Eu^{152-154}$ in the gammagraphy of welds in shipbuilding was studied. Their advantages over Co^{60} are listed. A study from the point of view of sensitivity resulted in the following recommendations for use: Se^{75} for thickness up to 20 to 25 mm, Ir^{192} up to 60 mm, and Cs^{137} from 40 to 100 mm. Two types of operating portable containers were developed. Irradiation with and without x-ray intensifying screens is discussed. (M.C.G.)

13492 (AEC-tr-4492(p.403-5)) EXPERIENCE OF THE APPLICATION OF THE ISOTOPE Ir^{192} AT THE RIGA SHIP REPAIR PLANT. V. O. Birshtenin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Mashinostr. i Priborostr., p.352-4.

The use of Ir^{192} in the control of thin-walled, all-welded cylinders is described. In order to avoid frequent replacement of the source, preparations with a large initial activity (2 to 3 c) are used. It was established that grooves possessing a depth of 0.15 mm and comprising 5% of the thickness of the base metal or 3% of its total thickness are clearly distinguishable. An empirical formula was derived for determining exposures. (M.C.G.)

13493 (NP-tr-870) THE DETERMINATION OF ION ADSORPTION AND ZERO-POINT POTENTIAL WITH THE AID OF LABELLED ATOMS. N. A. Balashova (Balaschova). Translated by W. Bleyberg (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Z. physik. Chem. (Leipzig), 207: 340-9(1957). 19p.

Experimental results relating to the adsorption of anions from labeled sulfuric acid, phosphoric acid, and hydriodic and hydrobromic acids on platinized platinum electrodes are reported. The adsorption of K, Cs, Sr, La, and Y cations with labeled atoms on similar electrodes is also reported. The experiments were conducted in acidified salt solutions and extend throughout a range of potentials between the reversible H potential and a value which is more positive than the O potential. (J.R.D.)

13494 RADIATION STERILIZATION. E. M. Darmady, K. E. A. Hughes, M. M. Burt, B. M. Freeman, and D. B. Powell (Wantage Research Lab., Berks, Eng.). Nuclear Energy, 112-15(Mar. 1962).

The radiosterilization of disposable medical items was investigated. Various vegetative and spore-bearing bacteria were irradiated, and results indicate that 2.5 Mrad can be recommended to give a high degree of sterility. Spores of B. pumilus (E.601) showed such resistance that it might be a suitable test organism for determining the efficiency of a radiation treatment. A high standard of packaging must be demanded for pre-sterilized products. (auth)

13495 THE USE OF ABSORPTION OF RECOIL RADIATION IN MEASUREMENT OF SEPARATED AEROSOL SAMPLES. Čestmír Jech (Inst. of Physical Chemistry, Czechoslovak Academy of Sciences, Prague). Staub, 20: 403-4(Nov. 1, 1960). (In German)

The absorption of recoil atoms in the aerosol layer deposited on a membrane filter was investigated experimentally. It was found that the absorption of the recoil atoms depends not only on the total quantity deposited but also on the diameter of the particles. The relation is expressed in a simplified mathematical presentation. The possibilities of application in dust measuring technology are discussed. (auth)

13496 ROENTGEN RAYS TO MAKE HAUSBOCK LARVAE IN WOOD VISIBLE. Hans Schmidt (Bundesforschungsanstalt für Forst- und Holzwirtschaft, Reinbek, Ger.). Umschau Fortschr. Wiss. u. Tech., 62: 82-3 (Feb. 1, 1962). (In German)

The use of roentgen rays in order to observe directly the behavior of the larvae of the Hausbock beetle in wood is discussed. The roentgen process makes it possible to detect insects in wood and determine the amount of damage they cause. (M.C.G.)

ISOTOPE SEPARATION

Refer also to abstract 12839.

13497 (CEA-2009) CINETIQUE DES CONCENTRATIONS DANS UNE USINE DE SEPARATION ISOTOPIQUE. (Concentration Transients in a Gaseous Diffusion Plant). R. Jacques and O. Bilous (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 36p.

Concentration transients are examined in the case of a gaseous diffusion plant for U isotope separation. An application is made to a plant having two rectifying cascades of different sizes and a stripping cascade. Transients are calculated for a change in the feed concentration, for a change in the transport, and for the shutdown of a group of separating stages in one of the cascades. (tr-auth)

13498 (CEA-2074) ETUDE DES REACTEURS D'ECHANGE ISOTOPIQUE. (Study of Isotopic Exchange Reactors). Pierre Grandcollot and Grégoire Dirian (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 78p.

A study is made of the general case of the theory of first-order isotopic chemical exchange between gaseous and liquid phases in a reaction vessel, starting from fundamental reaction kinetic data and making no limiting hypotheses concerning the value of the separation factor. Both counter-current and co-current reaction vessels are considered. The concepts of the quotient, over-all efficiency, and ratio of such reaction vessels are developed for the case of H_2 and D_2 separation. The search for an additive value for reactors in series leads to the definition of an exchange capacity and a total efficiency (or number of theoretical reactors). The relationships between these various quantities are established. The reactor performance is linked to the first-order reaction kinetics by the transfer number. The relationships are given for a number of cases. Applications of the calculations are given, together with the approximations necessary when, because of the presence of several components in each phase, the exchange reaction does not obey a single kinetic law. (auth)

13499 ON THE INDUSTRIAL ADAPTABILITY OF THE PACKINGS OF THE HEAVY WATER DISTILLATION TOWER. Masami Shimizu (Showa Denko K.K., [Japan]), and Shozo Matsumoto. Nippon Genshiryoku Gakkaishi, 4: 85-94(Feb. 1962). (In Japanese)

Various kinds of packing material for industrial use in the packed water rectification system for enriching heavy water were investigated. Discussion is given on mechanical properties including deformation in long use, relation between the column diameter and the requirement of packing, and void of packing; effects on rectification including variations in H.E.T.P. with column diameter and height and increase in H.E.T.P. through long use of packing; effects on pressure loss by steam flow rate and column diameter; hold-up; comparison of required periods to attain equilibrium on the basis of the factor of (H.E.T.P.) $\cdot H_T/L$, which represents the properties of packing; and economic evaluation of packing. Results on the availability of various packings for industrial installation with major emphasis laid on the McMahon packing, indicates that 0.5 in. McMahon packing is most preferable in effecting commercial production by the rectifying column for enriching low or medium-concentrated heavy water. (auth)

13500 PROCESS FOR THE PRODUCTION OF WATER OR HYDROGEN ENRICHED IN DEUTERIUM. (to Friedrich Uhde G.m.b.H.). British Patent 892,087. Mar. 21, 1962.

A process is given for producing H_2O or H_2 of greater than normal deuterium content in conjunction with NH_3 synthesis. In the process, the starting H_2 is impoverished in deuterium by isotope exchange with liquid NH_3 which was produced from impoverished H_2 and then pre-enriched in deuterium by isotope exchange with normal H_2O, and the further enriched NH_3 is either burned to NO_2 and enriched H_2O or cracked to N_2 and enriched H_2. (D.L.C.)

MATHEMATICS AND COMPUTERS

Refer also to abstract 13920.

13501 (JUL-25-PP) EINE KLASSE STATIONÄRER MARKOWPROZESSE. (A Class of Stationary Markov Processes). Wilhelm von Waldenfels (Kernforschungsanlage. Institut für Plasmaphysik, Jülich, Germany). July 28, 1961. 134p.

Thesis submitted to Technische Hochschule, Aachen.

Methods for solving the problems of stationary Markov processes were extended to cover as broad a class as possible. The basis for the solutions in the mass and distribution theories is discussed. A short summary of the necessary theory of the normalized vector space which was completed through the theory of integration of vector functions is given. Integrated masses and distributions are introduced and some of their characteristics are described. The rigorous convergence of integrated masses was considered and its usefulness shown. The idea and classification of these stationary Markov processes are described including the homogeneous stationary type. The LB_n in the simple continuous process is discussed. A generalization was made of mixed processes. A preliminary discussion is presented of the convergence and form of the limits of $[U(t,a)-\int a]/t$ for $t \to 0$. (M.C.G.)

13502 (NYO-9601) ON THE GREEN'S FUNCTION FOR THE LINEARIZED VLASOV EQUATION. Harold Weitzner (New York Univ., New York. Courant Inst. of Mathematical Sciences). Jan. 15, 1962. Contract AT(30-1)-1480. 54p. (MF-26)

This paper considers the Vlasov equation without magnetic fields, linearized about a state with no electric fields or space and time variation. Integral representations for the Green's functions are presented for systems of one, two, and three dimensions. For the one-dimensional stable case, two asymptotic expansions of the electric field for large time are presented. Similar expansions are given for a specific example of a one-dimensional unstable plasma. In two and three dimensions, asymptotic expansions are exhibited for arbitrary plasmas having cylindrical or spherical symmetry. (auth)

13503 (PPAD-432C) IBM 650 PROGRAM FOR TWO-BODY KINEMATICS. Technical Report No. 26. Kenneth Edwards (Princeton–Pennsylvania Accelerator, Princeton, N. J.). Oct. 2, 1961. Contracts AT(30-1)-2137 and Nonr-1858(06). 14p.

A program is given for calculating the kinematics of reactions in the form particle (1) + particle (2) → particle (3) + particle (4) where particle 2 is at rest. (J.R.D.)

13504 (WAPD-TM-240) TITE–A DIGITAL PROGRAM FOR THE PREDICTION OF TWO-DIMENSIONAL TWO-PHASE HYDRODYNAMICS. R. I. Miller and R. S. Pyle (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1962. Contract AT(11-1)-GEN-14. 112p.

TITE, a program which predicts the steady-state and transient two-dimensional flow of water in a heated vertical rectangular channel having a non-uniform axial and transverse heat flux distribution at the walls is described. The conservation laws were applied to the channel by finite difference techniques using a control volume concept. The model treats the two-dimensional transfer of mass, momentum, and energy throughout the subcooled, nucleate, and bulk boiling regions of the coolant using semiempirical heat transfer and pressure drop correlations. TITE is designed to be used in conjunction with either a mass velocity or static pressure drop driving function as well as power-time variations obtained from either experiment or other sources such as the ART program. The program was assembled by the ALTAC system for a 32,000 word Philco 2000 computer. (auth)

13505 ON A CERTAIN NON-LINEAR DIFFERENTIAL EQUATION. J. L. Synge (Dublin Inst. for Advanced Studies). Proc. Roy. Irish Acad., A62: 17-41(Dec. 1961).

The following non-linear differential equation, developed for a study of the structure of the nucleon core was solved: $\nabla^{11} + 2r^{-1}\nabla^1 - \nabla - \nabla^2 = 0$, with the normalization condition $\int_0^\infty r^3\nabla^2 dr = Mf^2/2\pi\mu$. The discussion includes the phase-plane, power series for $u(=-1/x)$, the recurrence formula, a numerical calculation of x starting from $t = 0$, asymptotic representation of x and y for large values of t, the case of arbitrary dimensionality, existence of the sequence fn(t), and the linear approximation in α. (M.C.G.)

13506 NEW GRAPH PAPER FOR THE ANALYSIS OF GAUSSIAN DISTRIBUTIONS. Peter Onno (McGill Univ., Montreal). Rev. Sci. Instr., 32: 1253-5(Nov. 1961).

A graph paper on which a Gaussian function of unit amplitude appears as a straight line was produced in an attempt to devise a method which would combine the obvious advantages of a linear presentation with the improved definition and convenience of a differential plot. A semilogarithmic plot of the linear differential pulse-height spectrum of 622 kev gamma ray from a Cs^{137} source is given as an example of the technique. The method requires only the data points from the multichannel analyzer and an estimate of the maximum height of the photopeak above background. Gaussian plots proved convenient checks on instrumental reliability; amplifier nonlinearity or drift cause noticeable deviations from linearity. (P.C.H.)

13507 THE OPTIMAL DESIGN OF CHEMICAL REACTORS. A STUDY IN DYNAMIC PROGRAMMING. Rutherford Aris. Mathematics in Science and Engineering. A Series of Monographs and Textbooks. Volume 3. New York, Academic Press, 1961. 200p.

Some of the problems in chemical reactor optimal design are treated by the methods of dynamic programming. The mathematical principles underlying dynamic programming are explained. The basic equations for reactions and reactors are set up and the objective function needed to define a realistic optimal problem is discussed. The significant problems for the main types of chemical reactors (continuous flow stirred tank reactor, multibed adiabatic reactor, tubular reactor, and batch reactor) and the optimal operation of existing reactors in which only some of the variables can be optimally chosen are dynamically programmed. (N.W.R.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

Refer also to abstracts 12834, 13436, 13438, 13485, 13486, 13488, 13489, 13490, 13491, and 13492.

13508 (AD-262812) RESEARCH AND DEVELOPMENT ON HIGH-PRESSURE HIGH-TEMPERATURE METALLURGY. Progress Report No. 6, April 9, 1961–July 8, 1961. (Manufacturing Labs., Inc., Cambridge, Mass.). July 1961. Contract AF33(616)-6837. 53p.

Development of the high-pressure liquid media cell is described. The recrystallization kinetics of pure Cu was restudied at annealing temperatures of 88 to 140°C. Studies on the martensite and austenite transformations in Fe–C systems and carbon steel at a pressure of 42 kilobars are discussed. A scaled-up MIA system was made for high-pressure heat treatment of steels, and preliminary data are given for the effect of tempering at 37 kilobars pressure on the mechanical properties of AISI 52100 steel. Chemical synthesis experiments were carried out at high pressure in the systems Mo–C, Si–C, B–Si, and Sb–B. (D.L.C.)

13509 (AERE-EL/M.86) ADHERENT EVAPORATED FILMS. J. Biram (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1, 1954. 9p.

Methods for obtaining adherence in evaporated films are considered. It is concluded that simple vacuum-baking techniques are quite reliable and satisfactory in producing mechanically resistant depositions. (auth)

13510 (BM-RI-5951) CHEMICAL REACTIONS IN THE ELECTRIC ARC: REACTIVE METAL CARBIDES. E. D. Calvert, M. M. Kirk, and R. A. Beall (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Nov. 1960. 16p.

The electric-arc reduction of Zr and Hf oxides with C yielded a metal–metallic carbide mixture. The carbon to oxide ratio in the feed determines the metal to carbide ratio in the product. A sample of this product was produced for testing as a feed for the deBoer iodide-dissociation process. A new technique for producing pure carbides is described which uses the intense heat of the arc to volatilize the carbide. The condensed vapor forms crystals of nearly stoichiometric carbide. (auth)

13511 (DC 59-1-17) SINTERING KINETICS OF BERYLLIUM OXIDE-PROGRESS REPORT #1. E. A. Aitken (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 17, 1958. Contract AT(11-1)-171. 11p.

Work in progress on studies pertaining to the kinetics of sintering of BeO is reported. A brief description is given of the various models by which BeO can sinter, and experimental data are presented which indicate a new mode of sintering unlike any of the mechanisms proposed before. (auth)

13512 (DMIC-Memo-145) THE USE OF NICKEL-BASE ALLOYS IN THE ROTATING PARTS OF GAS TURBINES FOR AEROSPACE APPLICATIONS. C. H. Lund (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Jan. 11, 1962. 25p.

A survey is presented of the use of nickel-base alloys in rotating machinery placed on auxiliary power units and starters for aircraft, ground-support equipment, and on turbopump units for missiles. The survey is concerned primarily with the materials requirements and specifications for intended uses. A summary is included of present and proposed manufacturing and fabrication methods for the materials. (B.O.G.)

13513 (HW-60886) REPORT OF INVENTION. THE PREPARATION OF URANIUM DIOXIDE BY FUSED SALT ELECTROLYSIS. W. L. Lyon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 25, 1959. Contract [AT(45-1)-1350]. 2p.

A method for the preparation of high-purity UO_2 is described. The process consists in the precipitation of UO_2 from a molten salt solution containing uranyl chloride by the action of an electric current passed between electrodes immersed in the melt. (M.C.G.)

13514 (NAA-SR-Memo-7079) GUIDE TO THE LITERATURE ON THERMOELECTRIC MATERIALS. J. B. Vetrano (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 1, 1962. Contract [AT(11-1)-Gen-8]. 45p.

The thermoelectric properties of numerous semiconducting materials are indexed. The source material used for the search was the progress reports from thirty-five Department of Defense sponsored contracts on thermoelectric materials. Abstracts of these contracts are also included. (auth)

13515 (NP-11591) PREPARATION AND EVALUATION OF HIGH PURITY BERYLLIUM. Final Report [for period] November 2, 1960 to November 1, 1961. Grant E. Spangler, Marvin W. Herman, and Edward J. Arndt (Franklin Inst. Labs. for Research and Development, Phidelphia). Contract NOw-61-0221-d. 66p. (F-A2476)

Zone refining procedures for vertical floating-zone type zone melting of beryllium are described. Single crystals prepared from zone melted beryllium were tested in tension with their orientation arranged to yield basal plane slip. The critical resolved shear stress varied from 2400 to 400 psi, decreasing with increased purification; the glide strain varied from 16 to 220% increasing with increased purification. Procedures for the rolling of several single crystals of beryllium are described and the results of recrystallization studies on them are presented. (auth)

13516 (TID-15138) THE INFLUENCE OF GRAVITY UPON THE SHRINKAGE OF COPPER POWDER COMPACTS. F. V. Lenel, H. H. Hausner, O. V. Roman, and G. S. Ansel (Rensselaer Polytechnic Inst., Troy, N. Y.). [1961]. Contract [AT(30-1)-2408]. 9p.

The possibility that gravity forces might play a role in the shrinkage behavior of compacts was investigated. Compacts were fabricated from irregularly shaped, electrolytic copper powder. The compacts were sintered at a temperature of 925°C generally for 1 hr. The samples were supported in various ways during sintering. The average radial shrinkage of the samples was of the order of 6%, the average axial shrinkage of the order of 5% for compacts pressed both from the +325 and the –325 mesh fractions of powder. In all cases, the part of the compact which had the highest axial compressive force due to gravity during sintering exhibited less radial shrinkage than the part of the compact which had lower axial forces. The samples for which the top and bottom axial shrinkages were measured showed greater axial shrinkage in the bottom half which had the highest

axial compressive force due to gravity during sintering. (M.C.G.)

13517 (TID-15139) ELECTRICAL RESISTANCE MEASUREMENTS OF SINTERING. F. V. Lenel, M. J. Salkind, H. H. Hausner, and G. S. Ansell (Rensselaer Polytechnic Inst., Troy, N. Y.). [nd]. Contract AT(30-1)-2408. 8p.

Mechanisms besides diffusion which may contribute to sintering during the initial stages at low temperatures were investigated. The experiment was designed to measure rates of neck growth in "real" powder agglomerates. Results indicated that a deformation mechanism contributes to bonding during the early stages of sintering. The most probable deformation mechanism for this temperature range and stress range is cross slip. The particular mechanism considered is the recombination of an extended screw dislocation along a critical length necessary to bow out a dislocation line in the cross-slipped plane. Measurements were made of electrical resistance with time in order to determine the rates of neck growth. (M.C.G.)

13518 (TID-15339) MODIFICATION OF LAMELLAR EUTECTIC STRUCTURES. G. A. Chadwick (Harvard Univ., Cambridge, Mass.). [1961?]. Contract AT(30-1)-1956. 28p.

The effect of impurity elements on the microstructure of metal eutectic alloys was investigated. The characteristic structure of all eutectic alloys is shown to be lamellar. The effect of impurity elements on the microstructure is two-fold. Long-range constitutional supercooling can arise ahead of the entire interface giving rise to a cellular interface and colony microstructure. Short-range constitutional supercooling localized to the region just ahead of one of the phases and bounded by the neighboring lamellae results in the formation of rods of one phase in a matrix of the other phase. (auth)

13519 CONTRIBUTION TO THE UNDERSTANDING OF THE MECHANISM OF URANIUM ELECTROREFINING IN FUSED-SALT BATHS. G. Boisde, G. Chauvin, H. Coriou, and J. Hure (Centre d'Etudes Nucléaires, Saclay, France). Electrochim. Acta, 5: 54-71(Oct. 1961). (In French)

Very pure U can be obtained by electrorefining, using an electrolyte of UCl_3 (~30 wt %) dissolved in LiCl–KCl eutectic, a cathode of Mo, an Ar atmosphere, and a temperature of 400 to 450°C. The detailed mechanism of this refining process is investigated by electrode-potential studies. It is found that UCl_3 contains an impurity (perhaps UH_3) that interferes with the yield of the cathode deposit, and a treatment is proposed to eliminate this impurity. It is further found that the quasi-reversible character of the system $U^{3+} \rightleftharpoons U^0$ is the principal reason for the production of high-purity uranium. The cathodic deposition and anodic dissolution seem to be primary reactions. The presence of moisture in the molten bath has a very harmful influence on the over-all electrorefining process, namely: the uranium obtained contains many impurities; the cathode current efficiency falls from 80 to about 10 per cent; and the anode is substantially corroded, the apparent anode current efficiency rising from 90 to about 120 per cent. An interpretation of these effects is given, based on the experimental polarization curves. (auth)

13520 BERYLLIUM OXIDE WHISKERS AND PLATELETS. P. L. Edwards and R. J. Happel, Jr. (Naval Ordnance Lab., White Oak, Md.). J. Appl. Phys., 33: 943-8 (Mar. 1962).

Beryllium oxide platelets and whiskers are grown by heating beryllium metal in a silica furnace tube and boat with a hydrogen atmosphere for 16 hr at 1500°C. Three distinct types of whiskers form: one type was parallel to the crystallographic c axis, another in the basal plane ([$\bar{1}$010] direction), and the third in an intermediate direction (approximately the [$\bar{3}$032] direction). The first type are called "flagpole" whiskers because they are topped by small balls of metallic appearance; they grow at the site of the original metal charge. These whiskers have pores along their axes, except in rare instances in which, instead of a pore, a whisker may have disconnected voids along its axis. Their axial growth rate is not observed directly, but is at least 0.02 μ/sec. The other two types have a more normal whisker appearance and grow at a distance from 0.2 to 2 cm from the original metal charge. They have no pores or voids. Their growth rate is at least 0.2 μ/sec. The larger platelets, which grow in the vicinity of the normal whiskers, are long in [$\bar{1}$010] direction and wide in the [0001] direction. Some of the smallest platelets grow in the basal plane. A mechanism of growth for the flagpole whiskers is proposed. It is assumed that molten beryllium balls are splashed onto a BeO substrate, and then react with water vapor to form whiskers which push the balls away from the substrate. The normal whiskers and platelets grow at a distance from the beryllium metal, and therefore their growth involves a vapor transport mechanism. (auth)

13521 PROTECTIVE COATINGS FOR URANIUM. L. W. Owen (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Less-Common Metals, 4: 35-9(Feb. 1962). (In English)

Interim results on evaluation of the protective quality of certain coatings applied to uranium are reported. Nickel coatings applied from the vapor phase by carbonyl decomposition showed a wide margin of superiority over certain electro-deposited coatings when exposed to air at 150°C (>140 days) and to boiling water (>170 days). While good bonding is important in limiting the rate of attack once initiated, the superiority of carbonyl nickel coatings on uranium must be attributed to other factors. (auth)

13522 STUDY OF HIGH-STRENGTH STEELS FORMED BY DEFORMATION AND HARDENING. L. I. Mirkin (Moscow State Univ.). Metalloved. i Termichesk. Obrabotka Metal., No. 1, 9-14(Jan. 1962). (In Russian)

A new method, combining thermal and mechanical treatments, was found to be very promising for improving the strength of steel. In most cases, martensitic transformation results in slip and in widening or narrowing of the crystal lattice. Sudden application of a load to a metal crystal containing dislocation centers results in the increase of dislocations. The exact succession of events during the transformation is not too well known; in some cases direct transitions from dislocation in the martensitic phase to those in the austenite may take place, considering the austenitic dislocations as phase recrystallisation centers. Chromium and carbon tool steels (corresponding to W-5 and W-1 types) which exhibit austenitic regions at temperatures ranging from 450 to 600°C were subjected to investigation by compressing the specimens heated to 1050 to 1150°C. It was found that the hardness of the specimens increased to a greater extent than in the case of heat treatment without deformation. The newly imparted properties were retained even at high annealing temperatures. The observed widening of the x-ray diffraction lines confirmed the proposed mechanism of this thermomechanical treatment. (TTT)

13523 THERMOMECHANICAL TREATMENT OF BALL-BEARING STEELS. M. L. Bernshteĭn, E. L. Demina, and K. E. Safonova (Moscow Steel Inst.). Metalloved. i Termi-

chesk. Obrabotka Metal., No. 1, 23-8 (Jan. 1962). (In Russian)

The effect of the newly developed thermomechanical treatment on Soviet ball-bearing steels was investigated, using both cylindrical and flat specimens. The test specimens were exposed to annealing temperatures ranging up to 550°C, followed by cooling in air. The thermomechanical treatment resulted in a marked improvement of the bending strength of the steel accompanied by an increase of its plasticity. The treatment, applied with a high degree of deformation, was also found to reduce the influence of the annealing temperature on the dimensions of the coherent grains. Ground materials did exhibit grain growth, up to high annealing temperatures. This might explain the occasionally observed effect of cold working. (TTT)

13524 EFFECT OF THE THERMOMECHANICAL TREATMENT ON THE CUTTING STRENGTH AND DUCTILITY OF CUTTING STEELS. M. M. Shteinberg, L. B. Sabun, and T. S. Shabashova (Ural Polytechnic Inst., USSR). Metalloved. i Termichesk. Obrabotka Metal., No. 1, 29-37 (Jan. 1962). (In Russian)

As previous studies of the subject were concerned primarily with structural steels, it was thought of interest to investigate the effect of thermomechanical treatment on cutting steels. While it was assumed that this treatment increases the wear resistance, special attention was paid to the problem of ductility, especially in the case of brittle high-Co steels. The steel specimens with an austenite formation temperature of 1250 to 1270°C were preheated to 860°C in a molten-salt bath. Plastic deformation studies were carried out by hammering during which the square cross section of the specimens was retained. It was found thermomechanical treatment at temperatures corresponding to the supercooling of the austenitic phase increased the cutting strength of the usual steels and did not affect the Co-containing alloys. Best results were obtained by treatment at 400°C; at the 650 to 700°C range the strength of the specimens studied was reduced. The function of strength vs profile reduction passed through a maximum at 15% reduction; at 20 to 30% reduction the martensite point of the residual austenite during annealing is by about 30°C lower than that of not deformed steels. The thermomechanical treatment does not affect greatly the complete transformation of the residual austenite. (TTT)

13525 THE QUANTITATIVE ANALYSIS OF MICROSTRUCTURE WITH DENSITOMETER DATA. R. J. Allio (U. S. Atomic Energy Commission, Washington, D. C.) and C. H. Randall. Trans. Met. Soc. AIME, 224: 221-7 (Apr. 1962).

An automatic system for the quantitative analysis of microstructure was developed. The method is based upon a statistical model of microstructure and employs phase intercept fractions as fundamental random variables. Structure-sensitive properties can be related explicitly to parameters derived from the distribution of phase intercept fractions in a material. (auth)

13526 METHOD OF FORMING A PROTECTIVE COATING ON STEEL SURFACES. (to U. S. Atomic Energy Commission). British Patent 892,280. Mar. 21, 1962.

A method is given for coating steel surfaces to inhibit the corrosive attack of liquid metal, e.g., liquid Bi and its alloys with Pb and/or Sn. The method comprises heating a steel containing C, N, and Al, Ti, or Zr to form a stable nitride by reaction of at least 50% of the N content with the Al, Ti, or Zr, and contacting the steel surface with a liquid metal containing >2 ppm Al, Ti, or Zr at 550 to 1100°C to form a layer of Al, Ti, or Zr carbide on the surface. The surface may also be protected against erosion by employing a liquid metal containing >2 ppm Zr. (D.L.C.)

13527 METHOD FOR FORMING A COATING OF MOLYBDENUM CARBIDE ON A CARBON BODY. Massoud T. Simnad (to U. S. Atomic Energy Commission). U. S. Patent 3,028,256. Apr. 3, 1962.

A method is described for coating a carbon body with molybdenum carbide in such a manner that the carbon body is rendered less permeable to the flow of gases and has increased resistance to corrosion and erosion. The method includes coating a carbon body with molybdenum trioxide by contacting it at a temperature below the condensation temperature with molybdenum trioxide vapors and thereafter carburizing the molybdenum trioxide in situ in an inert atmosphere on the carbon body. (AEC)

13528 ALUMINUM PRODUCTION METHOD. Alan W. Searcy and D. J. Meschi (to U. S. Atomic Energy Commission). U. S. Patent 3,031,294. Apr. 24, 1962.

A process for producing aluminum metal by the thermal dissociation of aluminum carbide is described. The process comprises the heating of aluminum carbide, in a vacuum of about 10^{-6} atmosphere, to free the aluminum and carbon according to the reaction: $Al_4C_3 \rightarrow 4Al\uparrow + 3C\downarrow$. From about 1600 to 2300°K, the aluminum is gaseous and may be distilled away from the precipitated carbon and condensed. The process provides for the exclusion of sources of potential contamination such as moisture, oxygen and nitrogen, the latter being a heretofore unrecognized indirect source of contamination. The process requires considerably less energy than the electrolytic method for producing aluminum. (AEC)

13529 GRAPHITE IMPREGNATION METHOD. F. Kertesz and H. J. Buttram (to U. S. Atomic Energy Commission). U. S. Patent 3,031,342. Apr. 24, 1962.

A method for impregnating a refractory material by filling its pores with a first salt having a high melting temperature is described. The salt is mixed with another, more volatile salt, giving the mixture a much lower melting temperature than that of the first salt. The material is coated with the mixture, then heated to drive off the volatile salt, leaving the first salt in place. (AEC)

Corrosion

Refer also to abstracts 12836 and 13003.

13530 (AERE-R-3881) THE OXIDATION AND CORROSION OF ZIRCONIUM AND ITS ALLOYS. XIII. SOME OBSERVATIONS OF HYDRIDE IN ZIRCONIUM AND ZIRCALOY-2 AND ITS SUBSEQUENT EFFECT ON CORROSION. B. Cox and T. Johnston (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1962. 19p.

An examination of hydride platelets in Zr and Zircaloy-2 by autoradiography and electron-microscopy showed that normal metallographic techniques provide a satisfactory method for identifying hydride in these materials. The standard methods do not give a good estimate of the size (particularly the thickness) of hydride platelets. Studies showed that the hydride platelets are very thin (500-1000A) and that the greater apparent thickness of them, when observed metallographically, results from etching out of the hydride together with some of the surrounding metal. No positive correlation was established between the presence of hydride at the oxide/metal interface and breakdown of the

oxide film during the oxidation of either Zr or Zircaloy-2. The cracking of the oxide which is associated with the sites of hydride particles is apparently mechanical in nature. (auth)

13531 (EURAEC-30) CORROSION PROBLEMS. 2nd Quarterly Report, June 1 to August 31, 1960. (Brussels. Centre Belge d'Etude de la Corrosion; Brussels. Centre d'Etude l'Energie Nucleaire; Brussels. Societe d'Etudes, de Recherches et d'Applications pour l'Industrie). Sept. 1960. Work performed under United States-Euratom Joint Research and Development Program. Contract [006-60-3-RDB]. 120p.

Work on potentiostatic and corrosimetrical research, chrono-potentiometrical investigations, research under irradiation, and special methods of preparing and examining samples is discussed. The behavior at 25°C of rust-proof steels was investigated. A study is being made of the potential-time curves of aluminum. Research on the influence of increasing quantities of NaCl on the potentiostatic behavior of steels in bicarbonic solution was continued. Work was also continued on building and elaborating equipment for the purification of aluminum and the production of aluminum monocrystals. (M.C.G.)

13532 (MND-E-2727) ANPP CORROSION PROGRAM. Final Summary Report. I. C. Mayes and J. McGrew (Martin Co. Nuclear Div., Baltimore). Feb. 1962. 115p.

Results are presented of a program to investigate the suitability of various materials for heat exchanger fabrication in nuclear power plants and to investigate the effects of various water treatments on the performance of these materials. Static autoclave and dynamic loop tests were performed. Results of tests showed that Inconel is superior to all other materials tested in simulated nuclear service. A wide range of environments from high purity water to water containing high chloride concentrations was used. The criteria of comparison included resistance to general corrosion, pitting corrosion, crevice corrosion, and susceptibility to stress corrosion cracking. AISI Type 304 austenitic stainless steel, AISI Type 430 ferritic stainless steel, Inconel, Monel and Ni were tested in tilting autoclaves. Test exposures varied considerably, as did environmental composition. The Type 304 stainless steel cracked severely in 120-hour tests. The Type 430 stainless steel pitted badly in 120-hour tests. Inconel suffered very slight incipient attack after 2000 hours' exposure to a severe environment. Both Monel and nickel pitted somewhat after 2000 hours' exposure to a severe environment. (auth)

13533 INFLUENCE OF IMPURITIES ON THE HIGH TEMPERATURE CORROSION AND REACTION KINETICS OF ZIRCONIUM IN HYDROCHLORIC ACID. W. E. Kuhn (Carborundum Co., Niagara Falls, N. Y.). Corrosion, 18: 103t-15t(Mar. 1962).

The corrosion of zirconium of four different analyses including iodide, Hf-free reactor grade, an Hf-containing high purity grade, and an Hf-containing low purity grade zirconium, was studied at 150 to 250°C in an aqueous solution containing 20% HCl. Studies of the reaction kinetics and surface phenomena were made in extensive experiments. The results of the experimental work are discussed with detailed consideration being given to the role of impurities, the heterogeneous nature of corrosion, the influence of the electrolyte, surface preparation, and diffusion barriers. It was concluded in general that small concentrations of specific impurity elements which formed precipitate phases had a powerful influence on the dissolution rate of zirconium and the resistance of primordial oxidic protective films. Iron, nickel, chromium, manganese, and silicon as impurities are believed to be most detrimental to the corrosion resistance of annealed zirconium in the form of precipitate particles acting as anodic corrosion centers. Various ways of improving the corrosion resistance of zirconium in HCl are either suggested or implied in the experimental results and their discussion. (auth)

13534 ELECTROCHEMICAL ASPECTS OF THE CORROSION OF AUSTENITIC STAINLESS STEEL IN A NITRIC MEDIUM AND IN THE PRESENCE OF HEXAVALENT CHROMIUM. H. Coriou, J. Hure, and G. Plante (Centre d'Etudes Nucléaires, Saclay, France). Electrochim. Acta, 5: 105-11(Oct. 1961). (In French)

The corrosion of austenitic stainless steels in boiling nitric acid increases markedly when the medium contains hexavalent chromium ions. Because of several redox phenomena, the potential of the steel generally changes with time. Measurements show a relation between the weight loss and the potential. Additions of Mn(VII) and Ce(IV) are compared with that of Cr(VI), and show that the relation is a general one. The attack of the metal in oxidizing media is largely intergranular, leading to exfoliation of the grains. Also, even in the absence of any other oxidizing reaction, the current density observed when the steel is anodically polarized under potentiostatic conditions does not correspond to the actual weight loss of the metal. (auth)

13535 WHAT EVERY ENGINEER SHOULD KNOW ABOUT STRESS CORROSION OF ALUMINUM. D. O. Sprowls and R. H. Brown (Alcoa Research Labs., New Kensington, Penna.). Metal Progr., 81: No. 4, 79-85 (Apr. 1962).

Discussion is given on the control of stress corrosion in high-strength aluminum alloys, factors causing stress corrosion, accelerated corrosion testing, variations in test specimens, sampling procedures that affect results, evaluating exposure tests, and correlation of test environments. Special attention is given to good engineering practices which have reduced the degree of susceptibility to such a level that their use has not been hampered. (P.C.H.)

13536 STAINLESS Cr–Mn–Ni STEEL WITH Ti, Nb, AND Mo. A. P. Gulyaev and Yu. S. Medvedev (Central Scientific Research Inst. of Ferrous Metals, USSR). Metalloved. i Termichesk. Obrabotka Metal., No. 2, 21-8(Feb. 1962). (In Russian)

Studies of Cr–Mn–Ni steel tendencies toward intracrystalline corrosion at 450 to 800°C show that austenite-forming elements (Ni and Mn) enhance the corrosion while Nb and Ti prevent it. Alloying with Mo improves properties for applications at 550 to 600°C. (R.V.J.)

13537 EXAMINATION APPARATUS FOR CAVITATION TEST IN LIQUID METALS. CORROSION OF IRON AND STEEL IN LIQUID METALS. Yūnoshin Imai (Tohoku Univ., Sendai), Yoshimitsu Kikuchi, and Tetsurō Isizaki. Nippon Genshiryoku Gakkaishi, 4: 77-84(Feb. 1962). (In Japanese)

To obtain exact and detailed information on a possibility of the occurrence of cavitation and further on a factor upon the cavitation in liquid metals, a test apparatus, consisting of the magneto-striction vibrator and the ultrasonic oscillator (18 to 22 kc), was assembled. From the results of testing in various liquid metals, such as Pb, Bi, and Hg, it was confirmed that the erosion, which is considered to be due to the cavitation effect, takes place. The macro-aspects of the cavitation damage differed widely by the kind of liquid metal, and the cavitation erosion effect became more marked with the rise of test temperature and with the in-

crease of the content of elements in the tested materials which are resolvable into liquid metals. It was concluded that the cavitation by liquid metals must be considered in the design of a liquid metal fuel reactor. (auth)

13538 CORROSION OF STAINLESS STEEL TUBES BY LIQUID SODIUM SYSTEMS. I. THERMAL CONVECTIONAL CORROSION TESTING APPARATUS. Hideo Atsumo (Hitachi, Ltd., [Japan]). Nippon Genshiryoku Gakkaishi, 4: 94-9(Feb. 1962). (In Japanese)

A new type thermal convectional corrosion testing apparatus was set up to study liquid sodium corrosion of stainless steel. In order to investigate several factors simultaneously, thermal calculation and structure of the apparatus and welding methods of the test pieces in NaK circulating loops were examined. Long term corrosion testing of 18-8 stainless steel tubes by high temperature NaK was effected quite well by this method. (auth)

13539 INTERCRYSTALLINE CORROSION AND CORROSION OF METALS UNDER STRESS. I. A. Levin, ed. Authorized Translation from the Russian. New York, Consultants Bureau, 1962. 325p. $18.00. Translated from "Mezhkristallitnaya Korroziya i Korroziya Metallov v Napryazhennom Sostoyanii." Moscow, Mashgiz, 1960.

Thirty-one papers are presented on the intercrystalline corrosion of stainless steels and the corrosion of stainless steel, carbon steel, low alloyed steel, and light and nonferrous alloys under stress. Special emphasis is placed on the general problems of corrosion and means for increasing resistance of the metals and alloys to corrosion. (N.W.R.)

Fabrication

Refer also to abstract 13437.

13540 (APEX-429) FABRICATION OF TUBULAR FUEL ELEMENTS. Final Report. E. M. Grala (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Sept. 9, 1958. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. Contracts AF33(600)-38062 and AT(11-1)-171. Subcontract AF-36. 26p.

Fabrication procedures for clad UO_2 dispersion-type tubular fuel elements were developed. Nichrome-clad, Nichrome-42 wt.% UO_2 assemblies were prepared. Fuel tubes were prepared by swaging and extrusion. Best results were obtained by extrusion. A fully bonded tubular fuel element was prepared. (auth)

13541 (APEX-546) PREPARATION OF SOLID MASSIVE SHAPES IN HYDRIDED ZIRCONIUM. A. J. Alexander and C. L. Huffine (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 1960. Contracts AF33(600)-38062 and AT(11-1)-171. 12p.

Techniques are described for hydriding large sections of Zr to a composition of ZrH_0 to $ZrH_{1.6}$. Optimum hydriding cycles involved equilibrium in a single-phase region of the phase diagram, but compositions that were confined to two-phase regions by equipment limitations were prepared. Equipment and methods of determining compositions are described. (J.R.D.)

13542 (CNIM-1784) PROJECT 1047, BONDING OF TANTALUM. Interim Report. S. L. Rogers (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). June 17, 1959. Contract [AT(11-1)-229]. 7p.

An investigation was conducted to determine the necessary requirements for obtaining sound bonded joints on Ta. It was found that sound bonds can be produced by resistance welding without the use of special atmosphere. Other tests conducted in vacuum-argon chambers and in plastic bags with argon were also successful. (J.R.D.)

13543 (DC-60-3-146) MACHINABILITY DATA SHEET NO. 17, EXTERNAL GRINDING OF CERAMIC TUBES. R. N. Samppala (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 15, 1960. Contract [AT(11-1)-171]. 19p.

Development of methods for grinding flats on BeO and depleted fuel tubes are discussed. A method is described which is acceptable and expeditious however refinements are required in order to reduce cracking during hexing operations and to increase the life of the relatively expensive diamond wheels. (J.R.D.)

13544 (FD-75) DEVELOPMENT OF A NEW BOOSTER ROD FOR NRX. J. S. Nelles (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1961. 8p.

For presentation at the Fourteenth Joint U.S.-Canadian Sheath Program Meeting, Savannah River Plant, Nov. 7 and 8, 1961.

A seven-element booster rod for NRX is in development. The cores are extruded from alloy billets composed of aluminum and highly-enriched uranium. The cores are extrusion clad with aluminum. Spiral fins locate the elements in spacers, which are welded in the coolant tube. Assembly and testing of the rod is discussed. (auth)

13545 (FD-77) THE FABRICATION OF THE CORES FOR THE MARK XIV 19-ELEMENT NRU ROD. G. C. Wootton (Atomic Energy of Canada Ltd., Chalk River, Ont.) Oct. 1961. 26p.

For presentation at the Fourteenth Joint U.S.-Canadian Sheath Program Meeting, Savannah River Plant, Nov. 7 and 8, 1961.

Results of tests run on the alpha-phase rolling, and the gamma-phase extrusion, of small-diameter uranium bars are outlined. Rolling tests are reviewed, and the effect on the quality of the as-rolled bars of such factors as roll-pass design, temperature control, surface and internal condition of the billet, and variations in metal composition are reported. The results of tests on the finishing of the as-rolled bars are also reported. Extrusion tests are also reviewed, and such factors as die design, die materials, and handling problems are discussed. The results of direct quenching of the extruded bars are also included. (auth)

13546 (HW-62347) EXTRUSION CHARACTERISTICS OF URANIUM–ZIRCONIUM AND URANIUM–CARBON ALLOYS. J. C. Tverberg and J. J. Holmes (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1961. Contract AT(45-1)-1350. 51p.

Extrusion characteristics were determined for a series of uranium–zirconium and uranium–carbon alloys in the range of 0 to 2 wt % zirconium and 40 to 1600 ppm carbon. Small zirconium additions to the uranium rapidly increased the extrusion coefficient whereas carbon additions only resulted in a gradual increase. Heat-treated material had a lower extrusion coefficient than the as-cast alloys. In each case the extruded material was softer than the unextruded metal. There was no appreciable hardness change in the uranium as the carbon content increased; however, the uranium–zirconium alloys became harder with an increasing zirconium content. A uniform clad thickness was observed on all extruded heat-treated alloys above 0.25 wt % zirconium and 900 ppm carbon. Excessive clad thickness variation was observed on all the extruded as-cast material except the 2 wt % zirconium alloy. A de-

creasing grain size was observed as the zirconium content increased. Heat treatment reduced this grain size still further. Some grain refinement was observed in the 1600 ppm carbon alloy, but none in the other uranium–carbon alloys. Excessive carbon in the zirconium–uranium alloys caused formation of a zirconium carbide in preference to the formation of zirconium–uranium compounds. When the carbide formed, the metal behaved differently than either the uranium–carbon or uranium–zirconium alloys. (auth)

13547 (NAA-SR-6226) VACUUM INDUCTION MELTING AND CASTING OF URANIUM–SILICON ALLOYS. N. H. Katz and M. H. Binstock (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 15, 1962. Contract AT(11-1)-Gen-8. 22p.

Development of procedures for vacuum induction casting of U–Si compounds is described. Melting and casting cycles were developed, and casting techniques established, which resulted in many sound, integral castings. Shapes cast include right cylindrical rods, ranging in diameter from $\frac{1}{4}$ to $2\frac{1}{2}$ in. and from $3\frac{1}{2}$ to 10 in. long; perforated hexagonal blocks, 5 in. between parallel sides by 7 in. long; and tri-segmented cloverleaf rods, 10 in. long having a segment diameter of $\frac{1}{2}$ in. Castings were evaluated by radiographic and metallographic examination, and by chemical analysis. Results indicate that large complex shapes of uranium silicides can be readily synthesized by vacuum induction melting and casting, which makes this process appear more attractive than arc casting for economical fuel fabrication. (auth)

13548 (NMI-7216) TUBULAR STAINLESS STEEL–ZIRCALOY TRANSITION JOINTS PREPARED BY TANDEM EXTRUSION. W. B. Tuffin, A. R. Gilman, and S. Isserow (Nuclear Metals, Inc., Concord, Mass.). Feb. 2, 1962. Contract AT(30-1)-1565. 36p.

Metallurgically bonded tubular joints of stainless steel and Zircaloy were prepared by tandem extrusion. The mechanical and corrosion behavior of these joints is limited by the Zircaloy rather than by the interface. The joints can be cold worked to at least 40% reduction in area without detriment to bond quality. An estimate was made of the cost of preparing 800 $3\frac{1}{2}$ in. joints using available commercial facilities. (auth)

13549 (NP-11555) RELATION OF MECHANICAL BEHAVIOR OF BERYLLIUM SHEET TO FABRICATION VARIABLES. Final Report, February 1960-March 1961. C. J. Giemza (Martin Co., Baltimore). Mar. 1961. Contract AF33(600)-40648. 53p. (RR-22)

Hot-pressed, hot-upset, and hot cross-rolled Be sheet samples were examined to assess their differences and advantages from a structural design viewpoint. Tension, notch tension, compression, bend ductility and box-beam tests, with the main emphasis on factors which tend to embrittle Be, were conducted. The results show that hot cross-rolled Be sheet exhibits both high strength and high elongation in tensile tests but is relatively brittle when, as in bending, the stress is complex. Hot-pressed Be sheet, which is low in tensile strength and elongation, demonstrates an excellent capacity for accommodating complex stresses in bending without fracture. The hot-upset Be sheet exhibited the best characteristics possessed by both hot-pressed and hot cross-rolled Be. The differences in mechanical behavior among the three groups are apparently a function of the degree of preferred orientation. However, the amounts of impurity elements which were reported could have contributed significantly to the embrittlement of the hot-pressed and hot cross-rolled beryllium sheet. The data are presented as trend curves and, when appropriate, in tabular form. (auth)

13550 (NP-11590) DEVELOPMENT OF AUTOMATIC QUALITY CONTROL FOR RESISTANCE WELDS IN ALUMINUM ALLOYS. PHASE I. A STUDY OF THE CHANGE IN WELD ZONE RESISTANCE IN SPOT WELDING ALUMINUM ALLOYS. Richard P. Hurlebaus (Budd Co. Materials Research Lab., Philadelphia). Feb. 20, 1962. Contract DA 36-034-ORD-3217-RD. 213p.

The study of resistance spot welding of several commercial aluminum alloys using three-phase power supply showed a correlation between the weld zone resistances and the weld nugget development. A three phase frequency converter spot welding machine with pulse counting timing was used for this study. Spot weld tests on 0.020" 2024, 2014, 7075, 5052, and 0.025" 5086, and 0.050" 2024, 2014, 7075, 5086, and 5456 alloys with recognized welding schedules were made to study the resistance-time characteristics of each material. These tests were used to determine what signals should be measured to provide an accurate picture of weld development. The electrode tip voltage and weld current were selected and measured for each weld. Weld tests showed the weld nugget was formed after one or two pulses of weld current. This was a desirable reference point. Also, the weld zone resistance-time graphs showed the resistances decreased continuously during weld time. The effect of welding variables on the weld zone resistance and weld size was the main objective of this study. The effect of weld current on the weld zone resistance was toward lower weld zone resistances as the weld current was increased for a given welding schedule. The increasing current, producing an increasing weld size correlated with an increasing percent change in weld zone resistance. The latter was calculated from the reference resistance (R_0) and the final resistance (R_f), excluding the initial contact resistance due to considerable inconsistency. The weld current produced the greatest reduction in the reference resistance (R_0) but reduced the final resistance (R_f) too. The increasing electrode forces produced a similar effect on the weld zone resistances as the weld current, however, the magnitude of the changes were not as large. The weld time affected the final resistance (R_f) to a greater extent than the reference resistance (R_0) for a given weld schedule. The longer weld times produced a lower final resistance. The correlation of weld zone resistance changes with weld size or strength was less predictable in the 0.020" gage than in the 0.050" gage. The 5086 and 5456 alloys were more predictable in the resistance change vs weld size than were the heat treatable alloys, 2024, 2014, and 7075. Electrode tip shape produced a decreasing weld zone resistance with time for increasing tip radius and a given welding schedule. The resistance-time graphs showed a lesser magnitude of the instantaneous resistance with increasing radius for a given weld schedule. Resistance spot welding of dissimilar alloys and gages indicated the weld zone resistances were more characteristic of the resistance-time graphs for the thinner material. (auth)

13551 (ORO-527) HELICAL FINNED TUBE DEVELOPMENT. Technical Report No. 237-235. Quarterly Report, October 17, 1961 to January 15, 1962. E. A. Murphy and J. G. Klein (Brush Beryllium Co., Cleveland). Jan. 15, 1962. Contract AT(40-1)-2912. 21p.

Results are presented of work toward development of a process for production of helical finned Be tubing by warm extrusion and drawing. (J.R.D.)

13552 (YAEC-159) DEVELOPMENT OF PELLETIZATION PROCEDURE FOR UO_2 PELLETS FOR YANKEE CORE I. R. Winchell (Westinghouse Electric Corp. Atomic

Power Dept., Pittsburgh). June 15, 1960. For Yankee Atomic Electric Co., Boston. Contract AT(30-3)-222, Subcontract 1. 153p.

Progress in simplification of UO_2 pelletization is described, and raw material and product specifications are given. The results of investigations of powder properties and their correlation with powder behavior, methods of repelletizing scrap pellets, methods of preparing press feed, attempts at shrinkage and hour-glassing control, investigations to reduce pellet costs and improve pellet density, more rapid means of determining pellet density, recommendations for packaging of UO_2 pellets, and miscellaneous subjects such as the preparation of stable water suspensions of UO_2, the blending of enrichments, and some data on the water corrosion resistance of UO_2 pellets are reported. (auth)

13553 RECENT RESEARCH IN METAL FORMING. John E. Hockett (Los Alamos Scientific Lab., N. Mex.). Appl. Mechanics Revs., 15: 157-66(Mar. 1962).

The fundamental research in progress or recently completed is reviewed and described along with a few of the results of recent applied research and development work in metal forming. This research is being conducted to obtain a better understanding of metal flow under various conditions. The bibliography contains 89 references. (N.W.R.)

13554 PRECISION BRAZING OF LARGE COMPONENTS. E. C. Buckingham (Superweld Corp., North Hollywood, Calif.). Metal Progr., 81: No. 4, 112; 114; 120(Apr. 1962).

Trimming coils for the cyclotron at Lawrence Radiation Laboratory, two of the largest precision brazement ever fabricated, required a special brazing alloy with low outgassing characteristics. Specifications, variety of alloys used, brazing alloy and cycle, and manufacturing methods employed in the fabrication of the trimming coils are discussed. The large brazement measured 10 ft in diameter, weighed 2280 lb, and was manufactured to extremely close dimensional tolerances. (P.C.H.)

13555 GAS-PRESSURE BONDING OF REFRACTORY METALS. E. S. Hodge (Battelle Memorial Inst., Columbus, Ohio). Metals Eng. Quart., 1: No. 4, 3-20(Nov. 1961).

A solid-state bonding technique involving the use of gas pressure at elevated temperatures was utilized for self-bonding of refractory metals. In addition, the process was utilized to clad, compact, and simultaneously clad and densify refractory-metal matrix dispersions. Results are described for Cr, Nb, Mo, Mo−0.5% Ti, Re, Ta, and W. (auth)

13556 WELDING REFRACTORY ALLOYS. W. R. Young (General Electric Co., Cincinnati). Metals Eng. Quart., 1: No. 4, 21-9(Nov. 1961).

Metallurgical considerations pertinent to refractory metal welding by the tungsten-inert gas process are discussed, procedures defined, and results of current experimental welding programs are presented. (auth)

13557 SINTERING OF COLUMBIUM POWDER. V. M. Amosov. Tsvetnye Metally, 35: No. 2, 60-5(Feb. 1962).

Vacuum sintering of niobium powder with an increased content of impurities was investigated in a vacuum of 10^{-3} mm Hg and at 15°C/min to 2350°C. The investigation showed that under the combined effect of high temperature and a vacuum a series of physical and chemical processes takes place resulting in the simultaneous sintering and refining of the metal. The refining begins at 1600°C, when removal of Fe and Ni and intensive evolution of gaseous CO and SiO are initiated. The Nb and Ta content in the compact increases proportionally to the extent of vaporization of the lower Nb oxides, whose appreciable volatilization begins at 1700°C. Within the temperature range 1800 to 2200°C the major part of the Fe, Ni, and Nb_mO_n is eliminated. This range is critical, a rapid temperature increase in this range resulting in the formation of blisters and blowholes. At temperatures above 1800 to 2000°C a noticeable removal of nitrogen is observed as the result of decomposition of Nb nitride; the most intensive removal occurs at 2250°C. Although at temperatures above 2000 to 2300°C the amount of Nb_2C and NbO_2 decreases considerably, additional holding at higher temperatures is required to remove the remainder of O, Ni, and Fe. Thus, up to ~1750°C the temperature can be raised rather rapidly; between 1750 and 2000°C it must be raised much more slowly, and still more slowly between 2000 and 2300°C. At 2000°C the compacts should be held for 0.25 to 2 hrs, depending on their diameter, and at 2300°C for 4 to 5 hrs. The total time of temperature increase to 2300°C for small specimens (5 × 5 × 120 mm) is 2 to 2.5 hrs and for large ones (20 × 20 × 600 mm), 10 to 11 hrs. The latter period can be decreased to 6 to 8 hrs when a purer powder is used. Under optimum conditions ductile metal is obtained in spite of an increased content of impurities. (OTS)

13558 HOW TO FUSION WELD BERYLLIUM. B. M. MacPherson and W. W. Beaver (Brush Beryllium Co., Cleveland). Welding J. (N. Y.), 41: 327-30(Apr. 1962).

Fusion welding of beryllium, with or without beryllium filler metal wire was sufficiently developed to provide consistently crack-free joints for weldments. Standardized principles for the use of the tungsten-arc method of fusion welding were evolved. Surface treatment, fixturing, welding set-up, welding current, post-heat treatment, and sheet orientation are discussed. (M.C.G.)

13559 RESISTANCE SPOT WELDING BERYLLIUM SHEET. Herbert A. Jahnle (Budd Co., Philadelphia). Welding J. (N. Y.), 41: 331-6(Apr. 1962).

It was determined that beryllium cross-rolled sheet can be resistance welded. Pre- and post-heating reduced the tendency for cracking by reducing the residual stress level during cooling. The cast nugget grain size was dependent on base metal grain size. Electrode sticking was reduced by improved surface finish. Beryllium weldments showed adequate strength only if proper design concepts were employed. It was concluded that resistance spot welding should be used mainly to keep the load carrying members in proper location. Resistance spot welding eliminated use of foreign metals in the joint. (auth)

13560 DIFFUSION BONDING BERYLLIUM COPPER FOR ULTRA HIGH-STRENGTH JOINTS. J. A. Hoffman, G. R. Baxter, R. C. Bertossa, and B. R. Cottrell (Univ. of California, Livermore). Welding J, (N. Y.), 41: 160s-6s (Apr. 1962).

Bond strengths averaging 108, 400 psi were developed in joining precipitation-hardened beryllium−copper by diffusion techniques. This is in contrast with an average of 40,000 psi obtained by ordinary brazing techniques. The method of diffusion bonding studied in this program involved the use of molten alloys of silver and gold to fill discontinuities at the bond interfaces. These molten filler alloys are, in turn, completely, or in some instances partially diffused into the base metals, resulting in sound and continuous base metal-to-base metal bonds. Data were also developed on the effects of heating beryllium−copper at 1550 and 1475°F on grain growth, elongation,

reduction in area, and elastic modulus to determine its usefulness as a high-strength fabricated material for unusual applications. (auth)

13561 METHOD OF MAKING FUEL BODIES. Walter V. Goeddel and M. T. Simnad (to U. S. Atomic Energy Commission). U. S. Patent 3,031,389. Apr. 24, 1962.

An improved method of making a fuel body containing carbon for reactors is described. Carbides of uranium and thorium having a particle size of from 100 to 500 microns are mixed with carbon having a particle size that will pass a 200 mesh screen but be retained by a 325 mesh screen, and 10 per cent by weight pitch. The mixture is heated to a temperature of about 700 to 900°C, at which point bonding is effected while maintaining it under mechanical pressure of over 3,000 pounds per square inch. The entire compact is heated to a uniform temperature during the process, preferably by electrical resistance of the compact itself. (AEC)

Properties and Structure

Refer also to abstracts 12835, 13416, 13417, 13418, 13419, 13420, 13421, and 13422.

13562 (AD-259116) RESEARCH AND DEVELOPMENT OF TANTALUM- AND TUNGSTEN-BASE ALLOYS. Final Report, June 27, 1958 through March 26, 1961. A. L. Feild, Jr., R. L. Ammon, A. I. Lewis, and L. S. Richardson (Westinghouse Electric Corp. Research Labs., Pittsburgh). May 26, 1961. Contract NOas 58-852-C. 212p.

The effects of alloying upon the properties of Ta and W were examined. A 20-g button survey was made of the Ta-W-Hf and Ta-W-Re ternary systems to determine hardness, fabricability, oxidation resistance, and microstructure as a function of composition. The effects of substituting or adding Ti, Zr, V, Cb, and Cr into Ta- and W-base alloys were also examined. A satisfactory technique was worked out for melting and fabrication of Ta-base alloys by arc melting from pressed and sintered electrodes and impact extruding at 1700°C with a Dynapak machine. The mechanical properties of the Ta-base alloys were determined from −320 to 3000°F on 50 mil sheet specimens. The alloys in general possess a remarkable combination of excellent low temperature ductility and substantial high temperature strength. (auth)

13563 (AFOSR-1757) THE LOW FIELD DE HAAS–VAN ALPHEN EFFECT IN ZINC (thesis). Technical Report No. 3. Alfred S. Joseph (Case Inst. of Tech., Cleveland). Nov. 1961. Contract AF 49(638)-621. 64p.

A study of the low field de Haas-van Alphen effect in zinc employing automatic recording of the variation of the torque as a function of the reciprocal of the applied magnetic field revealed six sets of periods. These periods were assigned in a consistent manner to portions of the free-electron model of the Fermi surface (single OPW). Cyclotron masses associated with the three larger sets of the observed periods were found to agree well with the theoretical estimates. Evidence was obtained for the presence of a spin-orbit energy gap across the hexagonal face of the first Brillouin zone near the corners. Thus, the validity of the single Brillouin zone construction was demonstrated for zinc. (auth)

13564 (AFOSR-2139) EFFECT OF VACUUM ENVIRONMENT ON THE MECHANICAL BEHAVIOR OF MATERIALS. I. R. Kramer and S. E. Podlaseck (Martin Co. Nuclear Div., Baltimore). Oct. 1961. Contract AF49 (638)-946. 50p. (RM-102)

Apparatus for conducting fatigue, tensile and creep studies in the pressure range 760 to 10^{-8} mm Hg is described. Experimental data are presented for aluminum single crystals showing, with decreasing pressure, an improvement in fatigue life and a decrease of strength in tension and creep. (auth)

13565 (APEX-680) CHROMIUM-BASE ALLOY DEVELOPMENT. J. E. Fox (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Apr. 1962. Contracts AF33(600)-38062 and AT(11-1)-171. 60p.

Progress in the development of chromium-base alloys for high-temperature applications is reported. The products of the major producers of high-purity chromium have been evaluated. Procedures have been established for melting and casting 10- to 70-pound ingots and converting these into useful sheet and bar products. These procedures include melting by the consumable arc, induction and nonconsumable skull process, and fabrication by press forging, extrusion, rolling and swaging. The major alloy systems investigated included Cr–Y, Cr–Fe–Al–Y, Cr–Re–Al–Y, and Cr–Ti–Zr–C–Y. Data on oxidation resistance, brittle-ductile transition temperature and tensile and stress-rupture properties are reported. (auth)

13566 (ARF-8203-17) STUDIES OF THE BRITTLE BEHAVIOR OF CERAMIC MATERIALS. Report No. 17 (Quarterly Report No. 1), December 1, 1961 to January 31, 1962. N. A. Weil, ed. (Illinois Inst. of Tech., Chicago, Armour Research Foundation). Feb. 19, 1962. Contract AF 33(616)-7465. 94p.

Work performed during the period is reported on investigations of strain rate on Al_2O_3, MgO, and BeO, effects of non-uniform stress fields on brittle materials, internal friction and lattice defects in single crystals and polycrystalline materials, effects of surface energy in brittle fracture, and impurity effects in Al_2O_3 and MgO. Other work is reported on effects of cyclic stressing on mechanical properties of MgO single crystals, effects of environment and surface condition on the ductility of MgO single crystals, and design of a multiple-spark camera for crack propagation studies. The program scope and basic concepts for an investigation to be conducted concerning the effects of porosity and thin metallic films on the strength of oxide ceramics are described. (J.R.D.)

13567 (ARL-66) RESEARCH ON FINE PARTICLE MAGNETIC MATERIALS. W. J. Schuele (Franklin Inst. Labs. for Research and Development, Philadelphia). Sept. 1961. Contracts AF33(616)-5041 and AF33(616)-6922. 64p.

Ferromagnetic and ferrimagnetic fine particles were prepared by suitably heat treating coprecipitated oxalates of the systems Co–Fe, Ni–Fe, and Cu–Fe in a wide range of compositions. Decomposition of the oxalates in hydrogen produced fine particle metals or alloys, while decomposition in air produced ferrites at temperatures as low as 400°C. Smaller particles were prepared by addition of the oxalates into molten potassium nitrate. Extremely fine particles were prepared by a precipitation process, and grown by a hydrothermal process, providing a series of ferrite particles from 25 to several hundred angstroms. Magnetic and physical measurements using x-ray and electron diffraction and electron microscopy techniques were examined. The magnetic and structural data were analyzed in terms of the theory of fine ferromagnetic particle. The existence of permanent magnet properties in fine particles of magnetic materials such as the ferrites was in accord

with the theory of single domain particles. Metal borides of Ni, Fe, and Co were prepared as fine particles using sodium borohydride as the precipitating agent. These were heat treated under various conditions and the magnetic properties observed. (auth)

13568 (ARL-239(Pt.II)) METALLIC OXIDE PHASES OF NIOBIUM AND TANTALUM. II. METALLOGRAPHIC STUDIES. Technical Note No. 2. N. Norman, P. Kofstad, and O. J. Krudtaa (Sentralinstitutt for Industriell Forskning, Blindern, Norway). Oct. 1961. 22p. (SI-Publ.-337).

A previous paper proved the existence of two niobium metallic oxide phases, NbO_x and NbO_2, and of two tantalum metallic oxide phases, TaO_y and TaO_2. Metallographic studies on polished and etched specimens show that NbO_x and TaO_y can not be distinguished from the metal phase. The isomorphous suboxides NbO_z and TaO_z form platelets in the metal. It appears that nucleation of the latter two suboxides is favored at sites of strain or imperfections in the metals. (auth)

13569 (CNLM-1729) BRAZE ALLOYS VS. ATMOSPHERES. Final Report. S. L. Rogers (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). May 21, 1959. Contract [AT(11-1)-229]. 4p.

An investigation is described to compare the compatibility of various furnace atmospheres with the contemporary braze alloys commonly used at CANEL and especially to evaluate PMC 2252, an Ar $2\frac{1}{2}$% H gas mixture. Induction brazing is the only application that was tried with this gas, on installations where it replaced a H atmosphere. No comparison was made with Ar or other inert gases but it is believed that the $2\frac{1}{2}$% H affords some beneficial cleansing action. 316 stainless steel assemblies induction brazed in the Ar–$2\frac{1}{2}$% H atmosphere came out clean and bright in joint areas, however, other areas of greater mass and where heat conduction was high, were tarnished a dull blue-gray color. Visually, fillets were good although small and flow appeared to be excellent. Results on specimens brazed in conventional atmospheres are tabulated. (auth)

13570 (CNLM-2989) EVALUATION OF COMMERCIAL CERAMIC COATINGS FOR SHORT TIME PROTECTION OF COLUMBIUM 1% ZIRCONIUM. D. W. McGrath (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Oct. 10, 1960. Contract [AT(11-1)-229]. 7p.

Fourteen commercial enamel frits from five different manufacturers were tested to determine their abilities to protect Nb–1% Zr during the forging cycle in the temperature range of 1800 to 2300°F. One frit was found to afford good coverage and protection at 2200°F at times up to 5 hours of exposure. Adherence was excellent during upset forging of a coated Nb–1% Zr sample heated 45 minutes at 2200°F. Another frit afforded good protection and coverage at 1700°F. (auth)

13571 (CW-R&DL-19) THE EFFECT OF HYDRIDING ON THE MECHANICAL PROPERTIES OF ZIRCALOY-2 FOIL. J. A. Green, W. T. Joyce, and M. J. Lavigne (Canadian Westinghouse Co., Ltd. Research and Development Labs., Hamilton, Ont.). Nov. 16, 1961. For Atomic Energy of Canada Ltd., Chalk River, Ont. 58p. (AECL-1415)

An internally insulated pressure tube concept was proposed, making use of stagnant heavy water layers as insulation and incorporating thin, dimpled, Zircaloy-2 foil both as separation for the layers and as support for the weight of the fuel. Hydrogen (or deuterium) pick-up in the foil was expected under operating conditions. The hydrogen pick-up in service was simulated by hydriding foil specimens using furnace charging techniques and also by static autoclaving foil specimens in high purity water at 360°C. Various levels up to 4000 and 2300 ppm respectively were achieved by the two methods. To determine the effect of hydrogen on the mechanical properties of the foils, static loading tests were carried out at room temperature and 288°C; room temperature cyclic loading tests and crushing tests of dimpled foil were also conducted. The reductions in strength and ductility with increasing hydrogen content were most pronounced in room temperature tests. Although strength and ductility were markedly reduced at the higher hydrogen levels, the foil retained adequate strength to support the calculated static load of the fuel. Cyclic loading tests at room temperature indicated a trend toward a limiting hydrogen level of 750 ppm above which fatigue type failures occurred. (auth)

13572 (DC-56-9-130) DESIGN INFORMATION ON ZIRCONIUM-HYDROGEN ALLOY. H. R. Stephan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). September 21, 1956. Contract AT(11-1)-171. 13p.

Properties of hydrided Zr are presented. Included are curves representing temperature vs density, thermal conductivity, strength, thermal expansion, electric conductivity, modulus of elasticity, and stability. (J.R.D.)

13573 (DC-58-1-38) THERMAL FATIGUE PROPERTIES OF INCONEL X MATERIAL (STRUCTURAL MEMO NO. 15)—MILESTONE V, TASK 7173. A. L. Ross (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 31, 1957. Contract AT(11-1)-171. 17p.

The results of an experimental program to determine the thermal fatigue properties of Inconel X material are presented. The material was thermal fatigued at an average temperature of 700°F. The maximum thermal fatigue cycle was a temperature variation between 100 and 1300°F. (auth)

13574 (DC-59-2-36) METALLURGICAL EVALUATION OF BURNER RIG CARTRIDGES OF XR-27 DESIGN TESTED AT VARIOUS DYNAMIC HEADS. G. T. Muehlenkamp (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 3, 1959. Contract [AT(11-1)-171]. 23p.

The metallurgical evaluation of burner-rig cartridges of XR-27 design tested at 1850°F and various dynamic heads (2.0 to 7.5 psi) is given. Results indicate no significant effect of dynamic head on the oxidation penetration in the Nb modification 80 Ni–20 Cr fuel elements. (auth)

13575 (DC-60-1-55) MATERIALS SURVEY–SUPER ALLOYS–RETAINER PLATE–CERAMIC CORE, PART II. F. M. Norton (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 7, 1960. Contract AT (11-1)-171. 32p.

A study is described in which DCM and Cosmoloy F nickel base alloys were selected as high temperature materials with useful mechanical properties at 1600 to 2100°F. These alloys are currently being specified for use in the D141Al core structure, i.e., retainer plate and support tube end. (auth)

13576 (HW-69832) THE LIQUIDUS FOR THE SYSTEM UO_2–PuO_2. T. D. Chikalla (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1961. Contract AT(45-1)-1350. 26p.

Melting points of UO_2 and PuO_2 in helium were found to be 2730 ± 30°C and 2280 ± 30°C, respectively. PuO_2 does not reduce to a sub-oxide during melting in helium; however, it evolves oxygen which results in an expansion of the unit cell, yielding O/Pu atom ratios of 1.62. Since oxygen is lost at melting temperatures, the equilibrium

melting point for $PuO_{2.00}$ will have to be determined under a partial pressure of oxygen; the 2280°C temperature reported is considered a pseudo melting point. The liquidus for the system UO_2-PuO_2 exhibits a melting maximum of 2825°C at UO_2-10 wt % PuO_2. Above this composition, the liquidus exhibits good continuity and reduces gradually with increased PuO_2 content. Lattice constants of melted UO_2-PuO_2 compositions vary linearly with PuO_2 content, but are slightly greater than anticipated. This is attributed to a loss of oxygen. (auth)

13577 (LAMS-2675) PROPERTIES OF TUNGSTEN OF INTEREST IN THE FIELD OF NUCLEAR POWER. A Selected, Annotated Bibliography. B. J. Thamer, comp. (Los Alamos Scientific Lab., N. Mex.). Jan. 15, 1962. Contract W-7405-Eng-36. 57p.

References (228) are given to patents, reports, and U. S. and foreign journals on fabrication, physical metallurgy, properties, preparation, and purification of tungsten and properties and coatings of tungsten alloys published from 1935 to November 1961. Reference texts and handbooks and sources of the metal are listed separately. The references are arranged by broad subject and alphabetically by author within each subject. (P.C.H.)

13578 (NAA-SR-6789) THE $Bi-BiBr_3$ AND $Bi-BiI_3$ SYSTEMS. S. J. Yosim, L. D. Ransom, R. A. Sallach, and L. E. Topol (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 30, 1962. Contract AT(11-1)-Gen-8. 15p.

The phase diagrams of the $Bi-BiBr_3$ and $Bi-BiI_3$ systems were determined. The experimental techniques included sampling at temperature, visual observations, conventional thermal analyses, and differential thermal analyses. The consolute temperatures (538° at 62 mole % Bi and 458° at 78 mole % Bi for the $BiBr_3$ and BiI_3 systems, respectively) are considerably lower than that of the $BiCl_3$ system (780° at 51 mole % Bi). The freezing point depressions of the metal-rich and salt-rich regions were analyzed. The salts dissolved in molten bismuth were found to have a cryoscopic number of 3. As in the $BiCl_3$ case, this effect can be explained by dissociation of BiX_3 solute or by reaction of BiX_3 with Bi to form the monohalide. In the case of the salt-rich regions the data did not fit a curve corresponding to one single mechanism over the entire liquidus. (auth)

13579 (NMI-7212) EVALUATION OF ZIRCALOY-4-CLAD U-1.5 w/o Mo TUBES NOS. 82 and 83. W. J. Richmond (Nuclear Metals, Inc., Concord, Mass.). Dec. 21, 1961. Contract AT(30-1)-1565. 28p.

Data obtained in the evaluation of tubes 82 and 83, extrusion nos. 29115 and 29116 are presented. The two tubes were produced to provide irradiation test material of 3% enriched U-1.5 wt.% Mo with the diameters of an outer HWCTR tube. Tube 82 met all specifications except that one pit was deeper than the 0.002-in. maximum allowed in the specification. Data on tube 83 are incomplete. (M.C.G.)

13580 (NP-11551) DEVELOPMENT OF TANTALUM-TUNGSTEN ALLOYS FOR HIGH PERFORMANCE PROPULSION SYSTEM COMPONENTS. Quarterly Report No. 9. September 21, 1961-December 20, 1961. R. W. Douglass (National Research Corp., Cambridge, Mass.). Contract NOrd-18787. 18p.

Two Ta-20W and a Ta-30W MERM nozzles were carburized to a depth of approximately 0.060 inch. MERM and ARC nozzles are being prepared from Ta-10, 15, 20, and 30W alloys. Series of tantalum, tantalum-tungsten alloys, and a Ta-10Hf alloy were carburized at 2300 and 2500°C. Tungsten additions to tantalum increased the rate of carburization, and the dimensional changes occurring during carburization at both 2300 and 2500°C. Tungsten additions also appeared to change the carbide morphology and phase relations in the Ta-C system. Ta-15 and 30W ingots were prepared for fabrication studies and subsequent fabrication rod and sheet. (auth)

13581 (PAN-254/I-B) THE CRYSTAL STRUCTURE OF TELLURIUM DIOXIDE: A REDETERMINATION BY NEUTRON DIFFRACTION. J. Leciejewicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 14p.

The crystal structure of tetragonal TeO_2 was studied using a neutron diffraction method. The space group is either $P4_12_12$ or $P4_32_12$ and the lattice constants are: a = 4.796 A; c = 7.626 A; c/a = 1.59. New O atom parameters were determined. The coordination polyhedron of the Te atom is a distorted square pyramid. The Te-O distances are 1.91 A twice and 2.09 A (twice). The pyramids are linked by common O atoms. A geometrical similarity of Te atom arrangement to the rutile type of structure is discussed. (auth)

13582 (R61SD010) THE VAPORIZATION OF GRAPHITE, TiC, ZrC, AND HfC. Guido L. Vidale (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Jan. 1961. Contract AF33(616)-6841. 54p. (AD-259469).

The vapor pressure over graphite, TiC, ZrC, and HfC is estimated from thermodynamic data. It is shown that the accuracy of the calculated pressure is limited by uncertainties in several thermodynamic properties. The data are extrapolated to high temperatures, and the magnitude of the error introduced is discussed. (auth)

13583 (RDB(W)-TN-63) THE APPARENT THERMAL CONDUCTIVITY OF GLASS WOOL. T. Burgoyne (Gt. Brit. Windscale Works, Sellafield, Cumb., England). Apr. 1953. 8p.

The thermal conductivity of glass wool is measured and compared with the value used in design of Windscale pile insulation. A linear variation with temperature is found, which appears to be independent of the density of packing in the range 4 to 12 lb/cubic ft. The lower values are in agreement with the design figure and the higher, less likely, values within 50 per cent of this. (auth)

13584 (TID-14808) THE EFFECT OF TEMPERATURE ON SOME RARE EARTH SESQUIOXIDE-THORIUM DIOXIDE SYSTEMS. Karl A. Gingerich (Pennsylvania State Univ., University Park and Freiburg i. B. Universität). [1961]. Contract AT(30-1)-2541. 7p.

A summary is given of an investigation by x-ray diffraction analysis of the influence of temperature on the properties of $ThO_2-Yb_2O_3$, $Eu_2O_3-ThO_2$, and $Pr_2O_3-ThO_2$ systems. Determinations were made of the lattice parameters by diffractometer and film techniques, and cubic-phase boundaries by the parametric method. The solubility of the sesquioxide component in the fluorite-type component is shown to increase with temperature. The rates of phase changes in different cubic dioxides and rare earth sesquioxides appear to increase as the difference between the corresponding lattice parameters of the oxide components increases. (B.O.G.)

13585 (TID-14950) STUDIES ON URANIUM CARBIDE FORMATION. Final Report. J. R. Piazza, M. J. Sinnott, J. D. Verhoeven, R. D. Balzhiser, E. E. Hucke, and D. V. Ragone (Michigan. Univ., Ann Arbor. Coll. of Engineering). July 31, 1959. For Babcock and Wilcox Co., Lynchburg, Va. Contract AT(30-1)-1940, Subcontract AT(30-1)-1940-5. 66p. (UMRI-2765-10-F)

The experimental study was initiated to establish what reactions would occur between bismuth-uranium-

zirconium–magnesium alloys, to what extent the reactions might proceed, and to obtain an estimate of the rates to be expected in the temperature range from 500 to 1100°C. Uranium and zirconium were found to form an isomorphous monocarbide. Uranium monocarbide was found to decompose above 480°C, when in contact with a bismuth–uranium solution containing 1000 ppm uranium. The presence of zirconium in the fuel solution produces a carbide layer which will accomodate small quantities of uranium. Thermodynamic calculations suggest the atomic ratio of uranium-to-zirconium in the carbide solution will increase with temperature from 5×10^{-9} at 500°C to 3.6×10^{-6} at 1100°C. Direct reaction of graphite with a typical fuel solution produced uranium-to-zirconium surface ratios of $\sim 10^{-1}$ at 600°C. No definite conclusions were made regarding the temperature dependence of the surface composition. (B.O.G.)

13586 (TID-14981) METASTABLE SIMPLE CUBIC STRUCTURES IN GOLD–TELLURIUM AND SILVER–TELLURIUM ALLOYS. Technical Report No. 2. Huey-Lin Luo and William Klement, Jr. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Feb. 1962. Contracts AT(04-3)-221 and Nonr-220(30). 25p.

By rapid cooling from the melt, single-phase simple cubic structures (one atom/unit cell) were obtained for alloys in the ranges, 15 to 40 at.% Au–Te and 20 to 30 at.% Ag–Te. Type measurements and resistivity estimates indicated that the simple cubic phases are metallic. Lattice spacings of the simple cubic phases were determined for single- and multi-phase alloys. The 37.5 at.% Au–Te alloy is relatively more stable than the other metastable phases, as shown by annealing experiments. (auth)

13587 (TID-15218) THE LITHIUM–STRONTIUM EQUILIBRIUM SYSTEM. Publication No. 1. Frederick E. Wang, Frank A. Kanda, and Aden J. King (Syracuse Univ., N. Y.). [1961]. Contract [AT(30-1)-1910]. 19p.

The complete equilibrium diagram of the lithium-strontium system was determined by the use of differential thermal analysis and x-ray diffraction methods at room and high temperatures. The system displayed limited solubility at both ends. The degree of solubility of lithium in strontium varied with the allotropic modification of strontium. These modifications were β(f.c.c.) up to 231°C; γ(h.c.p.) between 231 and 623°C; and δ(b.c.c.) above 623°C. Three compounds were formed by peritectic reactions: liquid + (γ) → Sr_8Li (h.c.p) at 496°C; liquid + Sr_8Li → Sr_3Li_2 at 198°C; and liquid + Sr_3Li_2 → Sr_6Li_{23} at 152°C. A congruent melting compound approximating the formula Sr_7Li (body-centered tet.) had a melting point of 584°C. This compound formed a eutectic with (δ) solid solution at a composition of 88.5 at.% strontium with a melting point of 578°C. Another eutectic formed between Sr_6Li_{23} and the lithium solid solution (α) at 12.5 at.% strontium with a melting point of 134°C. The compound, Sr_7Li and the (δ) solid solution decomposed by inverse peritectic reactions upon cooling; Sr_7Li → liquid + (δ) at 530°C; (δ) → liquid + (γ) at 515°C. The compound, Sr_8Li existed in two modifications, the high temperature form (h.c.p.) transformed on cooling into a room temperature form (tet.) within the temperature range of 196 to 198°C. (auth)

13588 (TIM-287) STRESS-RUPTURE AND CREEP PROPERTIES OF HASTELLOY X MATERIAL IN AIR AND LIQUID MEDIA. K. N. Burgess (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Oct. 11, 1956. Contract [AT(11-1)-229]. 40p.

Creep rupture data were obtained on Hastelloy X in sheet, plate, and bar form. Test temperatures of 1350, 1500, and 1650°F were used. Creep and stress-rupture were determined in air, salt, and liquid metal. The data are presented in graph form. (M.C.G.)

13589 (WAPD-252) THE ACCOMMODATION COEFFICIENTS OF HELIUM AND KRYPTON ON ZIRCALOY-2. J. M. Markowitz (Westinghouse Electric Corp., Bettis Atomic Power Lab., Pittsburgh). Feb. 1962. Contract AT(11-1)-Gen-14. 24p.

Accommodation coefficients of helium and krypton on Zircaloy-2 were measured in a single wire cylindrical cell by the constant pressure method as a function of temperature of the Zircaloy-2 filament over the range 40 to 350°C at cold surface temperatures of 42, 140, and 171°C. For gas-covered (contaminated) surfaces, the values of the accommodation coefficients for helium followed the equation $AC = (-1.66 \times 10^{-4}\ T_f + 0.368) \pm 0.020$ at 42°C and $AC = (-3.36 \times 10^{-4}\ T_f + 0.449) \pm 0.015$ at the higher cold side temperatures. For krypton, the gas-covered surface value at 42°C was found to be 0.861 ± 0.016, independent of filament temperature, while a single determination at 141°C led to a value of 0.96. (auth)

13590 (AEC-tr-5000) INVESTIGATION IN THE NIOBIUM–MOLYBDENUM–CARBON SYSTEM. E. Rudy, F. Benesovsky, and K. Sedlatschek. Translated by J. D. Farr and T. C. Wallace (Los Alamos Scientific Lab., N. Mex.) from Monatsh. Chem., 92: 841-55(1961). 25p.

The Nb–Mo–C ternary was investigated by x-ray and metallographic techniques on the basis of pressure-sintered, vacuum-annealed, and arc-melted alloys. A distribution of the phase fields at 1500 and 1900°C was undertaken. Reported phases in the Nb–C and Mo–C boundary systems were confirmed. The existence of the earlier reported hexagonal γ'-MoC was confirmed. The value for the free-energy of formation of $MoC_{1-x}(Mo_3C_2)$ is calculated from the tie line paths to be between 6 and 9 kcal/mol at 1850°C. On the basis of further thermodynamic deliberations predictions were made for other carbide systems. (B.O.G.)

13591 (AEC-tr-5023) PHASE DIAGRAM OF A TUNGSTEN–RHENIUM SYSTEM AND THE PROPERTIES OF ITS ALLOYS. E. M. Savitskii, M. A. Tylkina, and L. L. Shishkina. Translated for Oak Ridge National Lab., Tenn. from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 3, 99-107(1959). 14p.

A complete phase diagram of a tungsten–rhenium system was constructed. Comparative data of the two elements are given. Molten and thermal-treated alloys were investigated using metallographic and x-ray analyses, measurements of the melting temperature, hardness of the alloys, and microhardness of the structural components. Properties of tungsten–rhenium alloys were determined. (M.C.G.)

13592 (AEC-tr-5058) DIFFUSION OF RADON IN OXIDES AFTER RECOIL DOPING. R. Lindner and H. J. Matzke. Translated by Gordon R. Love (Carnegie Inst. of Tech., Pittsburgh) from Z. Naturforsch., 15a: 1082-6 (1960). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 14790.

13593 (CEA-tr-X-259) ALLIAGES DE BÉRYLLIUM. (Alloys of Beryllium). Translated into French from Italian Patent 353882 and addendum 357876. 1937. 56p.

A study is made of the mechanical and physical properties of alloys of the form X-(1.3 to 2.6%)Be-Y, where X is a metal chemically and crystallographically similar to Cu, Ni, Fe, or Al, and Y is a metal chemically and crystallographically similar to V, Mo, W, Ta, U, Ti, Zr, or Cr. The

effects of quenching and tempering operations on these alloys are also examined. Data are given as examples for the alloys Cu-Be-V, Ni-Be-Mo, Cu-Be-V-(3 to 4%)Fe, Ni-Be, and Cu-Be. The alloys are found to possess high rupture strengths, high electric conductivity, high tensile strengths, and hardness. (T.F.H.)

13594 (UCRL-Trans-764(L)) THE BEHAVIOR OF ALKALI METALS TO SEMI-METALS. V. THE ANTIMONY SYSTEM WITH POTASSIUM, RUBIDIUM AND CAESIUM. Friedrich Wilhelm Dorn and Wilhelm Klemm. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Z. anorg. u. allgem. Chem., 309: 189-203(1961). 17p.

According to the results of thermal analysis and x-ray investigations the following compounds exist in the systems: K–Sb, Rb–Sb, and Cs–Sb: K_3Sb, K_5Sb_4, KSb, KSb_2; Rb_3Sb, Rb_5Sb_2, Rb_5Sb_4, RbSb, $RbSb_2$, Rb_3Sb_7; Cs_3Sb, Cs_5Sb_2, Cs_2Sb, Cs_5Sb_4, CsSb, $CsSb_2$, Cs_3Sb_7. In the K–Sb system the densities of the new phases were determined. (auth)

13595 (UCRL-Trans-780(L)) BEHAVIOR OF STEELS WITH 11-20% CHROMIUM AFTER LONG-TIME HEATING IN 475°C EMBRITTLEMENT RANGE. Ewald Baerlecken and Heinz Fabritius. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Stahl u. Eisen, 78: 1389-95(1958). 19p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 12003.

13596 X-RAY LINE BROADENING STUDIES OF COLD-WORKED URANIUM. R. Krishnan, V. S. Arunachalam, and M. K. Asundi (Atomic Energy Establishment, Trombay, India). Acta Met., 10: 75-8(Jan. 1962).

X-ray line broadening studies on cold-worked uranium for various amounts of deformation were carried out. The necessity of obtaining the second-order reflections for separating the particle size effect from the lattice distortion was eliminated by disregarding the dimensional distribution of particle sizes. Fourier analyses of (111), (112), and (131) reflections show that fragmentation ceases after a certain deformation and strain reaches a saturation value. The stress was found to be more isotropic. The elastic strain energies for various deformations were calculated and it is seen that for large deformations a negligible amount of deformation energy goes into distorting the crystal lattice. (auth)

13597 A NOTE ON DIFFUSION IN METALS. Y. L. Yao (Dept. of Mines and Technical Surveys, Ottawa). Can. J. Phys., 40: 367-70(Mar. 1962).

It is shown that the lattice energy, adapted from the model of ionic compounds, can be used as a parameter in both binary-alloy and single-component systems. A plot is presented, showing the correlation between activation energy of self diffusion of metals and the product of absolute energy and absolute melting point. (L.N.N.)

13598 EQUILIBRIUM DIAGRAM OF THE La_2O_3–Y_2O_3 SYSTEM. Jeannine Cassedanne and Hubert Forestier (Faculté des Sciences, Strasbourg). Compt. rend., 253: 2953-5(Dec. 18, 1961). (In French)

The study of the La_2O_3–Y_2O_3 system showed the existence of α and β solid solutions with the same structure type as La_2O_3 (hexagonal) and Y_2O_3 (cubic). The existence of two definite compounds was also established: $La_2O_3 \cdot Y_2O_3$, already known, and $3La_2O_3 \cdot Y_2O_3$, unknown up to the present, and which is stable at high temperatures. (tr-auth)

13599 EFFECT OF INTERNAL TENSIONS ON THE COMPOSITION OF THE PHASES FORMED BY DIFFUSION IN URANIUM–COPPER AND URANIUM–ALUMINUM COUPLES. Michel Beyeler and Yves Adda. Compt. rend., 253: 2967-9(Dec. 18, 1961). (In French)

Considerable internal pressures occur during the formation of intermetallic compounds obtained by solid-state diffusion between uranium and copper and between uranium and aluminum. The pressures were shown by utilizing diffusion couples of different thicknesses. These pressures seem in large part responsible for the thermodynamic equilibrium variation observed later. (tr-auth)

13600 ON THE STATE OF CARBON IN TITANIUM, TANTALUM AND TUNGSTEN. I. N. Frantsevich and I. I. Koven'skii (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R., No. 11, 1471-4(1961). (In Ukrainian)

Carbon electrotransport in titanium, tantalum, and tungsten was investigated for carbon contents of about 0.1 wt %. The experimental data were used to determine the charges of the carbon ions in the given metals. (auth)

13601 SECTION NbC–C OF THE DIAGRAM OF THE NIOBIUM–CARBON SYSTEM. M. S. Koval'chenko and G. V. Samsonov (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R., No. 11, 1478-81(1961). (In Ukrainian)

The methods of metallographic investigation and determination of the melting points of NbC–C alloys made by hot pressing of mixtures of niobium carbide and anthracene soot at 2950 to 2980°C were used to study the interaction of the components and to construct a tentative diagram of the niobium–carbon system. It was established that the eutectic melting point lies between 2950 and 3000° and the eutectic point between 10 and 20 mol % C. (auth)

13602 LUBRICANTS FOR NUCLEAR REACTORS. Fluid Handling, No. 141, 287-92(Oct. 1961).

The range of operating conditions which lubricants are expected to encounter in different reactors is described, with particular emphasis on the CO_2-cooled, graphite-moderated reactor. Applications considered are in CO_2 gas circulators, control rod mechanisms, charge face machinery, high-temperature gas-cooled reactors, and research reactors. Nuclear lubricant requirements proposed by the UKAEA to cater for many applications are discussed. The types of test facilities necessary for the evaluation of lubricants are assessed and described. The effects of radiation on lubricants are described. (M.C.G.)

13603 ACTIVATION ENERGY IN STABILIZED β Ti CREEP. D. A. Prokoshkin, L. I. Ivanov, and V. A. Yanushkevich (Baikov Inst. of Metallurgy, USSR). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 5, 65-7(1961). (In Russian)

The activation energy of stabilized β titanium creep is independent of test temperature and applied force (13 to 26.3 kg/cm^2). Numerically the activation energy of β Ti creep at 13 to 26.3 kg/cm^2 is below the activation energy of β Ti self-diffusion and corresponds to the maximum Q values calculated using the conditions of solid to liquid transition. (R.V.J)

13604 VOLATILITY BEHAVIOR OF URANIA-LANTHANA SOLID SOLUTIONS. David C. Hill (Argonne National Lab., Ill.). J. Am. Ceram. Soc., 45: 143(Mar. 1962).

The volatility behavior of uranium oxide-lanthanum oxide solid solutions in a gas-fired furnace at 1675°C for 25, 136, and 310 hours is studied. The effect of composition on weight loss of exposed surface area is shown. Specimens containing more than 60 mole % $LaO_{1.5}$ had very low weight

losses and their loss rates were nearly constant. Microstructure examination indicated that grain growth and densification had occurred and that the specimen surfaces were relatively inert to attack by the furnace gases. Specimens within this range had O/M ratios below the stoichiometric $MO_{2.00}$ composition and were the most stable with regard to volatility behavior. The change from oxygen-deficient to an oxygen-excess structure appears to be a significant factor in the volatility behavior of these solid solutions. (N.W.R.)

13605 PIEZOELECTRIC AND DIELECTRIC PROPERTIES OF LEAD TITANATE ZIRCONATE CERAMICS AT LOW TEMPERATURES. Robert Gerson (Clevite Corp., Cleveland). J. Appl. Phys., 33: 830-2(Mar. 1962).

The piezoelectric and dielectric properties of polarized lead titanate zirconate ceramics were measured between 4 and 77°K. The materials were found to retain strong piezoelectric activity at the lower temperature. For one type of ceramic the planar piezoelectric coupling in liquid helium was about 80% of its room temperature value. Its free relative dielectric constant, measured at 1 kc, rose almost linearly from 380 at 4°K to 1300 at room temperature. The mechanical losses decreased sharply at low temperatures, suggesting a reduction in domain wall mobility. (auth)

13606 FLOW AND RECOVERY PROPERTIES OF NEARLY STOICHIOMETRIC POLYCRYSTALLINE URANIUM CARBIDE AND THE MECHANISM OF WORK HARDENING OF CRYSTALLINE SOLIDS. Roger Chang (Atomics International, Canoga Park, Calif.). J. Appl. Phys., 33: 858-63(Mar. 1962).

The flow and recovery properties of nearly stoichiometric polycrystalline uranium carbide are studied in the temperature range 1500 to 1900°C, at strain rates between 2×10^{-5} to 2×10^{-3}/sec. The flow data seem to follow a relationship $\dot{\epsilon} \cong K\sigma^5 \exp(-37{,}500/RT)$, where $\dot{\epsilon}$ is the strain rate, K a constant, and σ the flow stress at strain = 0.001. A mathematical evaluation from recovery data of the activation volume associated with dislocation motion is presented, and its implications regarding basic information on the mechanism of work hardening are discussed. (auth)

13607 SHOCK-WAVE COMPRESSION OF QUARTZ. Jerry Wackerle (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys., 33: 922-37(Mar. 1962).

High-explosive driving systems and high-speed optical techniques used to investigate the compressional behavior of x-cut, y-cut, and z-cut quartz crystals and fused quartz up to about 750 kbar. In both forms two-wave structures over a wide pressure range are identified as resulting from unusually high Hugoniot elastic limits. In crystalline quartz a dependence of the pressure of these elastic limits on driving shock pressure and sample thickness is associated with a relaxation-time phenomenon connected with the transition from elastic to fluid-like flow. Recovery experiments are reported that show that sufficiently high shock pressures result in the transition of crystalline quartz to the fused state, and the implications of the compression data in this regard are discussed. Observations on fused quartz demonstrate that shock-wave loading results in both anomalous compression at low pressures and the compaction phenomena above 100 kbar observed in hydrostatic experiments. (auth)

13608 A RAPID ELECTROLYTIC METHOD FOR THE PREPARATION OF METALLOGRAPHIC SURFACES ON FABRICATED BERYLLIUM. J. H. Dingle and A. Moore (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Inst. Metals, 90: 270-1(Mar. 1962).

A method described for the preparation of metallographic surfaces on fabricated beryllium is essentially an electrolytic process whereby a relatively strain-free surface, responding readily to polarized light, can be prepared easily and quickly on rolled or machined surfaces in either ingot or powder products. From the as-received condition, the specimen is preferably (though not necessarily) rough polished on two silicon carbide papers and electropolished on a modified Disa Electropol apparatus for 45 min. The electrolyte is composed of 3 vol phosphoric acid, 1 vol sulfuric acid, 1 vol glycol, and 1 vol alcohol. The total time for the process is approximately 1 h and involves complete attention of the operator for only 15 min. (P.C.H.)

13609 MICROCRACKS IN BERYLLIUM. J. T. Barnby (Fulmer Research Inst., Ltd., Stoke Poges, Bucks, Eng.). J. Inst. Metals, 90: 271-2(Mar. 1962).

Discussion is given on stress concentration below a tilt boundary which ends within a crystal and gives rise to basal cleavage in a hexagonal metal. If an obstacle to the gliding motion of a tilt boundary restricts its movement, part of the boundary may glide on leaving the other half behind, thus creating a stress concentration sufficient to overcome the cohesive forces between basal planes in a hexagonal metal. Splitting of the boundary may be aided by the pressure of glide dislocations behind the boundary. Discussion is also given on surface tilts and basal slips in the model of a Stroh crack (Stroh, Phil. Mag., 1958, 3, 597) which is shown in perspective. (P.C.H.)

13610 METALLIC OXIDE PHASES OF NIOBIUM AND TANTALUM. I. X-RAY INVESTIGATIONS. N. Norman (Central Inst. for Industrial Research, Oslo). J. Less-Common Metals, 4: 52-61(Feb. 1962). (In English)

Oxidation studies on niobium confirmed the existence of the tetragonal suboxide NbO_x with a suggested x-value of $\frac{1}{2}$. At temperatures between 400 and 500°C in oxygen of reduced pressure a new tetragonal metallic oxide, NbO_2, was found with a unit cell approximately 6 times that of the metal. The length of the axes is a = 6.64, c = 4.80 Å. Tantalum also forms two metallic oxide phases. The orthorhombic phase TaO_y with an estimated y-value of $\frac{1}{4}$ was known previously. On prolonged oxidation TaO_y transforms into a second suboxide, TaO_2, which is isomorphous with NbO_2. Its cell dimensions are a = 6.68, c = 4.75 Å. No indication was found of a Ta suboxide isomorphous with NbO_x. All the oxides have a metallic appearance and show an expected epitaxial growth. The composition, structure, and stability of the phases are not fully known. (auth)

13611 THE SOLUBILITY OF OXYGEN IN TRANSITION METAL ALLOYS. R. T. Bryant (Imperial Chemical Industries, Ltd., Birmingham, Eng.). J. Less-Common Metals, 4: 62-8(Feb. 1962). (In English)

The solubility of oxygen in niobium and solid-solution alloys of niobium with other transition metals of Groups IVA, VIA, VIIA, and VIIIA was measured. The solubility of oxygen in niobium over the temperature range 700 −1550°C obeys the relation: $-\log_e N = 8600/RT + 0.516$ where N is the atomic fraction of oxygen in solution. Additions of molybdenum, rhenium, and ruthenium to niobium all reduce oxygen solubility, zero solubility being reached when the electron/atom ratio of the alloy is about 5.75. Additions of titanium increase the oxygen solubility, but zirconium, which forms a very stable oxide ZrO_2, reduces oxygen solubility markedly. It is concluded that the solubility of oxygen in transition metal alloys is largely electronic in nature, solubility being small if the electron/atom ratio of

the alloy exceeds 5.75, and being very much larger in alloys of a lower electron/atom ratio, the oxygen dissolving with a positive charge. (auth)

13612 THE EFFECT OF NITROGEN ON THE YIELD STRENGTH OF NIOBIUM. P. R. V. Evans (Armour Research Foundation, Chicago). J. Less-Common Metals, 4: 78-91(Feb. 1962). (In English)

The tensile properties of electron-beam melted niobium and a series of niobium–nitrogen alloys containing up to 0.036 wt % nitrogen were examined at room temperature over a range of grain sizes. The variation of lower yield stress σ_{LY} with grain-size d was used to determine the values of σ_0 and k in a Petch type equation $\sigma_{LY} = \sigma_0 + kd^{-\frac{1}{2}}$. Whereas k was not influenced by nitrogen content and was, with one exception, immeasurably small, σ_0 was particularly sensitive to nitrogen content. Some dispersion-hardened structures (Nb_2N as dispersed phase) were studied and, employing the Petch equation, a quantitative measure of the contribution of the dispersion to yield strength was made. Using a Heslop–Petch type analysis, a measure of the Peierls–Nabarro force for the niobium lattice at room temperature was obtained. (auth)

13613 THE COMPOSITION OF ThH_2 AND DIFFUSION OF HYDROGEN IN ThH_2. D. T. Peterson and J. Rexer (Ames Lab., Ames, Iowa). J. Less-Common Metals, 4: 92-7(Feb. 1962). (IS-312). (In English)

The composition of thorium dihydride was determined as a function of temperature and pressure. By using this information, the diffusion coefficients of hydrogen in thorium dihydride were calculated from previous measurements of the parabolic reaction rate constants. The activation energy for diffusion was found to be 2.3 kcal and D_0 was $2.11 \cdot 10^{-4}$ cm^2/sec. (auth)

13614 SOME COMMENTS ON THE YTTERBIUM–THORIUM SYSTEM. Karl A. Gschneidner, Jr. (Los Alamos Scientific Lab., N. Mex.). J. Less-Common Metals, 4: 107-8(Feb. 1962). (In English)

Experimental observations showing that ytterbium and thorium exhibit very limited mutual solid and liquid miscibilities are shown to be in complete accord with prediction. Although ytterbium has an atomic size about 8% larger than thorium, and the electronegativity difference between the two elements is only 0.37 units, it has been shown that it is the simultaneous, not the individual, application of these two factors which is important in determining the extent of solid solubility. A plot given for thorium and ytterbium metals shows that thorium lies just outside the outer ellipse for ytterbium and that ytterbium lies beyond the outer ellipse for thorium. Therefore, very limited solid solubilities of thorium in ytterbium and vice versa are predicted. (P.C.H.)

13615 LOW ENDURANCE FATIGUE OF A MILD STEEL AND AN ALUMINIUM ALLOY. P. P. Benham and Hugh Ford (Imperial Coll. of Science and Tech., London). J. Mech. Eng. Sci., 3: No. 2, 119-32(1961).

Mild steel and an aluminum–zinc–magnesium alloy were tested axially under cycles of constant load range and constant total strain range at frequencies between 5 and 15 c/min for endurances from monotonic tension to 50,000 cycles. Mean loads or strains of zero and half the maximum in tension were studied. Hysteresis loops were recorded automatically at regular intervals throughout the life to failure. Two mechanisms of fracture were found for mild steel during load cycling, a necked-out type caused by cyclic creep, and conventional fatigue. The aluminum alloy did not exhibit this behavior and could not in fact be broken in repeated tension at endurances below 600 cycles. For strain cycling a linear relationship was found to exist when the logarithm of the total or plastic strain range was plotted against the logarithm of the number of cycles, for each metal and mean strain. Load and strain cycling results cannot be compared on the basis of the setting-up cycle (that is, the conditions for the first cycle), but only in the steady cyclic condition after work hardening or softening has occurred. During a test each of the metals worked toward a steady cyclic condition. A smooth curve is obtained when the total energy to fracture is related to the endurance, for all cases of load and strain cycling studied. (auth)

13616 ELECTRICAL RESISTIVITY OF UFe_2 AND UMn_2. Yoshikazu Hamaguchi, Nobuhiko Kunitomi, Shigehiro Komura, and Masanobu Sakamoto (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Japan, 17: 398(Feb. 1962). (In English)

Spin disorder conductivity in UFe_2 and UMn_2 was measured at 100 to 600°K and at the liquid-helium temperature. Data are presented in graphical form. It is indicated that a considerable amount of spin disorder conductivity in UFe_2 is caused by the small magnetic moment of U atoms. (L.N.N.)

13617 THE DEVELOPMENT OF ALUMINUM ALLOYS WITH HIGH MECHANICAL RESISTANCE. P. Brenner (Vereinigte Leichtmetall–Werke, Bonn). Met. ital., 53: 585-93(Nov. 1961). (In Italian)

A review is presented on the development of the high mechanical resistant alloys Al–Cu–Mg, Al–Zn–Mg, and Al–Zn–Mg–Cu. The Al–Zn–Mg alloys, developed in Germany, were introduced into aeronautics. The stress-corrosion problems of these alloys were resolved. Studies and investigations on further improving these high resistance alloys are illustrated. (tr-auth)

13618 THERMAL FATIGUE. E. Glenny (National Gas Turbine Establishment, Pyestock, Hampshire, Eng.). Met. Revs., 6: 387-465.

The significant factors influencing the thermal-fatigue behavior of metallic materials are reviewed and discussed in an effort to present a clearer picture of thermal-fatigue problems. The bibliography contains 171 references. (N.W.R.)

13619 STEELS FOR NUCLEAR POWER PLANTS IN BRITAIN. Tom Bishop (John Miles & Partners (London) Ltd.). Metal Progr., 81: No. 4, 97-100(Apr. 1962).

Metallurgical properties of steels currently in use in nuclear power plants and methods for improving the properties are discussed. Minimum properties of 3-in. thick steel plates used in reactor pressure vessels are tabulated. Creep resistance of weldable low-carbon, high-manganese steels used in reactor pressure vessels can be increased by adding molybdenum and vanadium. For higher operating temperatures, up to 2.25% chromium is added. Strict specifications for steels and their possible development is stressed. Brief discussion is given on neutron irradiation effects on steel properties. (P.C.H.)

13620 APPLICATIONS OF EI692 STEEL AT 800°C. I. S. Lupakov and V. P. Voeikov. Metalloved. i Termichesk. Obrabotka Metal., No. 2, 49-51(Feb. 1962). (In Russian)

Studies of the heat resistance, structural strength, and other physical properties of EI692 steel (0.05% C, 0.7% Mn, 0.19% Si, 15.29% Cr, 36.5% Ni, 2.5% W, 2.49% Mo, 1.48% Ti, 0.008% S, 0.023% P, 0.02% B, and 0.025% Ce) indicate high tensile properties at 800°C (6.8 kg/mm^2). The high strength

of the steel at 750 to 850°C endures for 10,000 hours. (R.V.J.)

13621 YOUNG'S MODULUS OF HOT-WORKED PYROLYTIC GRAPHITE. W. V. Kotlensky, K. H. Titus, Jr., and H. E. Martens (California Inst. of Tech., Pasadena). Nature, 193: 1066-7(Mar. 17, 1962).

Data are presented on the room-temperature Young's modulus of pyrolytic graphite in the direction of the basal planes after various amounts of hot working. Engineering stress-strain curves are given for both as-deposited and hot-worked specimens. Hot working is observed to increase greatly the modulus, e.g., from 2.5×10^6 for no hot working to 81.2×10^6 lb/in.^{2} for 16% hot-work elongation at 2750°C. (D.L.C.)

13622 HIGH-TEMPERATURE PHASE TRANSFORMATION IN BERYLLIA. T. W. Baker and P. J. Baldock (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 193: 1172(Mar. 24, 1962). (AERE-M-1017)

A high temperature x-ray diffractometer was used to investigate a reversible phase transition in beryllia at 2050°C. Evidence was obtained of a new phase appearing at 2080 ± 50°C on heating, which reverted to the usual hexagonal beryllia structure at 1980 ± 50°C on cooling. In each case the phase change took place over some 30°C. The high temperature phase seems to have pronounced cubic characteristics. The interplanar spacings of the new phase recorded over the angular range 35 to 140° (2θ) are tabulated. (P.C.H.)

13623 THE MIGRATION OF FISSION PRODUCTS IN GRAPHITE. G. N. Walton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Eng., 7: No. 70, 97-101(Mar. 1962).

The investigations show that for many fission products graphite is very impervious, even at very high temperatures. Products are highly mobile even when the pore structure of the graphite is reduced to a minimum, and this raises great difficulties in the use of graphite as a canning material for high temperature fuel. Attempts to overcome these difficulties include the fabrication of concentric cylinders or boxes to provide additional gaps for the fission products to jump. Graphite coated particles, which have cores larger than the recoil range and coatings of high density, were also developed. The mobility of certain fission products seems to be associated with high adsorptive properties and it is possible that these very properties will effectively keep a reactor coolant circuit clean; this is particularly true if advantage can be taken of a rapid turnover of fuel and its surrounding graphite. (auth)

13624 HIGH TEMPERATURE STRENGTH OF CLEAN GRAPHITE. G. W. Rowe (Univ. of Birmingham, Eng.). Nuclear Eng., 7: No. 70, 102-3(Mar. 1962).

Experiments show that the strength of graphite is greater when measured at high temperatures. Examination of the influence of atmosphere suggests however that the major factor determining the increase in strength is the removal of contaminating adsorbed gases, not the temperature itself. Clean graphite in high vacuum shows a high strength, which is immediately reduced on exposure to air. It is suggested that this factor should be considered in designing structural members of graphite for high-temperature installations. (auth)

13625 NUCLEAR RESONANCE FLUORESCENCE FROM THE 343-Kev LEVEL OF Lu^{175}. B. I. Deutch (Franklin Inst., Swarthmore, Penna.). Nuclear Phys., 30: 191-200(Feb. 1962). (In English)

Resonance fluorescence from the 343-kev level of Lu^{175} was studied by the centrifuge method. Assuming a branching ratio $\Gamma_0/\Gamma = 0.883$ to the ground state, a mean γ life of the 343-kev transition $\tau_\gamma(343) = (4.7 \pm 0.4) \times 10^{-10}$ sec was calculated from the resonance scattering measured at different source velocities. The angular distribution of the 343-kev resonance radiation from a Lu_2O_3 powder scatterer is isotropic. Combining the lifetime of the 343-kev level with the range of the mixing ratio $\delta^2 = E2/M1$ consistent with conversion studies and the angular distribution, it is calculated that the M1 transition from the 343-kev level to the ground state is hindered by a factor of 700 over the single particle prediction. This hindrance is a factor of 4×10^3 sec less than in a similar M1 transition from the 482-kev level to the ground state in Ta^{181}, despite the fact that both γ-rays result from hindered transitions between the same orbitals. (auth)

13626 THERMIONIC PROPERTIES OF HfC, NbC, ScB, $TuB_6 + TuB_4$. V. S. Fomenko (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Radiotekh. i Elektron., 6: 1406(Aug. 1961). (In Russian)

Descriptions are given of the thermionic properties of prepared HfC, NbC, ScB_2, and TmB_6 (with small admixture of TmB_4). The results of measurements carried out by the Richardson method of straight lines in straight channel diodes with safety rings are tabulated. (R.V.J.)

13627 ELECTRICAL PROPERTIES OF PYROLYTIC GRAPHITES. Claude A. Kelin (Raytheon Co., Waltham, Mass.). Revs. Modern Phys., 34: 56-79(Jan. 1962).

Pyrolized graphite samples are produced by pyrolytic deposition on substrates at temperatures of 1700 to 2500°C. A review is presented of the basal plane and c-direction conductivities, electrical anisotropy, Hall coefficient, and magnetoresistance of these samples, as functions of the deposition temperature and the ambient temperature. The data are analyzed in terms of carrier concentrations and mobilities, and in terms of other conduction mechanisms for graphitic systems. X-ray-diffraction analyses of the samples are also reported. (T.F.H.)

13628 PRECIPITATION OF ZIRCONIUM HYDRIDE IN ALPHA ZIRCONIUM CRYSTALS. D. G. Westlake and E. S. Fisher (Argonne National Lab., Ill.). Trans. Met. Soc. AIME, 224: 254-8(Apr. 1962). (ANL-FGF-285)

The habit planes for zirconium hydride precipitation in crystals of α zirconium were determined at various hydrogen concentrations. The $\{10 \cdot 0\}$ planes are the predominant habit planes; some $\{10 \cdot 5\}$ and $\{10 \cdot 1\}$ planes were observed after charging conditions which permitted formation of a surface layer of hydride. No platelets were observed parallel to any of the twinning planes. Mechanisms for embrittlement due to hydride precipitation are discussed. (auth)

13629 INTERNAL FRICTION OF TITANIUM AND ITS ALLOYS. D. R. Miller (Univ. of Melbourne). Trans. Met. Soc. AIME, 224: 275-81(Apr. 1962).

Internal friction and elastic modulus variations in electrorefined titanium, iodide refined titanium, and alloys of the latter material with oxygen, nitrogen, aluminum, and zirconium were investigated. No oxygen peak was detected with electrorefined titanium but, provided precautions were taken to prevent increases in background damping, an oxygen peak at about 410°C could be resolved with each of the other materials. An additional partially resolved peak was observed at 500°C in a Ti–N alloy. An anomaly in the variation of rigidity modulus with temperature was observed. Possible mechanisms for the formation of any oxygen peak are discussed. (auth)

13630 PROPERTIES AND HANDLING PROCEDURES FOR RUBIDIUM AND CESIUM METALS. T. D. Brotherton, O. N. Cole, and R. E. Davis (American Potash and Chemical Corp., Trona, Calif.). Trans. Met. Soc. AIME, 224: 287-93 (Apr. 1962).

Properties of rubidium and cesium are compared with those of other alkali metals. Methods for the preparation of rubidium and cesium metal are reviewed briefly, and hazards and safety precautions required in handling rubidium and cesium metal are described. Simple methods for handling laboratory quantities of elemental rubidium and cesium under oil or argon are illustrated. (auth)

13631 THE SELF-DIFFUSION OF OXYGEN IN A LIME–SILICA–ALUMINA SLAG. Peter J. Koros (Jones and Laughlin Steel Corp., Pittsburgh) and Thomas B. King. Trans. Met. Soc. AIME, 224: 299-306(Apr. 1962).

The self-diffusion coefficient of oxygen in a liquid silicate slag containing 40% SiO_2, 40% CaO, and 20% Al_2O_3, was determined using the capillary effusion technique. Two stable isotopes of oxygen (O^{17} and O^{18}) were used as tracers. After each diffusion run, the slags were reduced with graphite, the evolved carbon monoxide collected and converted into CO_2. The oxygen isotope concentrations were obtained by measuring the $(CO_2)^{45}/(CO_2)^{44}$ and the $(CO_2)^{46}/(CO_2)^{44}$ ratios of the gas. It was found that for O^{17} $D = 3.73 \times 10^5 \exp^{-85,000/RT}$ cm^2/sec and for O^{18} $D = 4.69 \times 10^5 \exp^{-85,000/RT}$ cm^2/sec. Exchange of oxygen between neighboring silicate anions, possibly accompanied by the rotation of these complexes, is a probable diffusion mechanism. The exchange of oxygen atoms between holes in the silicate lattice may also be postulated. (auth)

13632 TWINNING IN COLUMBIUM. Carl J. McHargue (Oak Ridge National Lab., Tenn.). Trans. Met. Soc. AIME, 224: 334-9(Apr. 1962).

Mechanical twins were produced in electron-beam melted niobium by high-speed impact at room temperature and by slow or fast compression at −196°C. The composition plane of the twins was $\{\bar{1}12\}$ and the shear direction was $\langle 111\rangle$. Notches in the twin bands often corresponded to traces of $\{110\}$ of the matrix and appeared to be untwinned regions. Markings within the twin bands were interpreted as resulting from $\{110\}$ slip in the twins. (auth)

13633 THE YTTRIUM–MANGANESE SYSTEM. R. L. Myklebust and A. H. Daane (Ames Lab., Ames, Iowa). Trans. Met. Soc. AIME, 224: 354-7(Apr. 1962). (IS-328)

The yttrium–manganese system was investigated by thermal, metallographic, and x-ray diffraction methods. There are three intermetallic compounds present: YMn_2 which melts congruently, YMn_4 which undergoes syntectic decomposition, and YMn_{12} which undergoes peritectic decomposition. The compound YMn_4 is ferromagnetic at room temperature with a Curie temperature of 214°C. There are eutectics at 25.2, 60.9, and 82.0 wt% Mn which melt at 878, 1100, and 1075°C, respectively. Crystallographic data are given for YMn_4 and YMn_{12}. The terminal solid solubilities are low. (auth)

13634 PHASE EQUILIBRIA OF THE GROUP IV_A METALS WITH YTTRIUM. C. E. Lundin and D. T. Klodt (Univ. of Denver). Trans. Met. Soc. AIME, 224: 367-72 (Apr. 1962).

The binary alloy systems Y–Ti, Y–Zr, and Y–Hf were investigated throughout their entire composition regions. There is no compound formation in any of the systems, and each system is characterized by a single eutectic reaction. The eutectic compositions and temperatures are as follows: Y–Ti system, $L \rightleftharpoons \beta\text{-Ti} + \alpha\text{-Y}$, 1385°C and 12.0 wt % Ti; Y–Zr system, $L \rightleftharpoons \beta\text{-Zr} + \alpha\text{-Y}$, 1385°C and 44.0 wt % Zr; Y–Hf system, $L \rightleftharpoons \alpha\text{-Hf} + \alpha\text{-Y}$, 1425°C and 23.0 wt % Hf. A eutectoid reaction: $\beta\text{-Ti} \rightleftharpoons \alpha\text{-Ti} + \alpha\text{-Y}$ at 0.4 wt % Y and 870°C occurs in the Y–Ti system, whereas a peritectoid reaction: $\beta\text{-Zr} + \alpha\text{-Y} \rightleftharpoons \alpha\text{-Zr}$ at 0.6 wt % Y and 880°C occurs in the Y–Zr system. Peritectic type reactions at temperatures above the eutectic levels are postulated for the yttrium and hafnium transformations. (auth)

13635 THE SYSTEM NIOBIUM (COLUMBIUM)–TITANIUM–ZIRCONIUM–OXYGEN AT 1500°C. Walter C. Wyder and Michael Hoch (Univ. of Cincinnati). Trans. Met. Soc. AIME, 224: 373-8(Apr. 1962).

The isothermal section of the Nb–Ti–Zr–O system at 1500°C was investigated using x-ray diffraction and metallographic techniques. Up to 66.7 at. % O, the system contains nine four-phase regions. Isopleths at 10, 20, 30, 40, 50, and 55 at. % O were constructed. (auth)

13636 THERMODYNAMICS OF TRANSITION METAL ALLOYS: GROUPS IV, V, AND VI ELEMENTS. Michael Hoch (Univ. of Cincinnati). Trans. Met. Soc. AIME, 224: 379-82(Apr. 1962).

The phase diagrams of binary systems of some of the transition elements of Groups IV, V, and VI were used to compute the partial free energies of these elements and the free energy of formation of their Laves-type compounds. From these data, isothermal sections of ternary phase diagrams were calculated and compared with experimental results. (auth)

13637 REACTOR MATERIALS. Technical Progress Reviews, Volume 5, No. 1, February 1962. R. W. Dayton, E. M. Simons, and R. W. Endebrock (Battelle Memorial Inst., Columbus, Ohio). 80p. (GPO) $0.50 (domestic), $0.65(Foreign)

Progress on the development of reactor materials is reported under the following topics: fuel and fertile materials, moderator materials, nuclear poisons, cladding and structural materials, special fabrication techniques, and general materials information. (M.C.G.)

Radiation Effects

Refer also to abstract 13316.

13638 (ARF-1188-1) EFFECTS OF SOLAR PLASMA AND ELECTROMAGNETIC RADIATION ON THIN FILMS AND SURFACES. Quarterly Report No. 1, March 15, to June 15, 1961. L. Reiffel (Illinois Inst. of Tech., Chicago. Armour Research Foundation). July 10, 1961. Includes appendixes: I. NOTES ON CONVERSATION BETWEEN PROFESSOR H. BRIDGE AND L. REIFFEL ON JULY 6, 1961. L. Reiffel. II. UPPER LIMITS ON INTERPLANETARY GAS DENSITY FROM METEORITE DATA. L. Reiffel. III. SPUTTERING CONSIDERATIONS, VISITS TO OTHER LABORATORIES, AND EQUIPMENT REQUIREMENTS. L. C. Scholz and R. G. Pohl. Contract NASr-29. 88p.

Effort on a program to examine the possible effects of ionized solar plasmas (alone or combined with simulated solar ultra-violet radiation) on the properties of surface and thin films is described. Calculations on expected plasma densities using age data for the Grant meteorite are presented along with the present state of direct interplanetary plasma observations with space probes. Also included is discussion of an experimental facility capable of plasma bombardments under kinetic ultra-high vacuum conditions.

Descriptions and photographs of related work being performed in other organizations are also presented. (auth)

13639 (EOS-2080-ML-1) FEASIBILITY STUDY TOWARD DEVELOPMENT OF RADIATION RESISTANT SOLAR CELL. Monthly Report No. November 1, 1961 through November 30, 1961. S. Kaye (Electro-Optical Systems, Inc., Pasadena, Calif.). Dec. 15, 1961. Contract NAS7-92. 8p.

A program is being carried out to investigate the feasibility of and to develop a radiation-resistant solar cell. A preliminary theoretical study was undertaken to determine the process parameters necessary to fabricate a graded base radiation-resistant solar cell. Material and equipment were obtained for experimental work. A preliminary diffusion experiment was carried out. (auth)

13640 (ERR-AN-085) A STUDY OF THE EFFECTS OF NUCLEAR RADIATION ON HIGH-STRENGTH AEROSPACE VEHICLE MATERIALS AT THE BOILING POINT OF HYDROGEN (−423°F). J. F. Watson, J. L. Christian, and J. W. Allen (General Dynamics/Astronautics, San Diego, Calif. and General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Sept. 27, 1961. 93p.

The problem of radiation damage occurring in structural materials at −423°F became of major importance during the studies of nuclear powered upper stage rockets. In this type of vehicle, large pressurized propellant tanks containing liquid hydrogen at −423°F are subjected to large doses of both neutron and gamma fluxes. Thus the structural materials experience a combined environment of cryogenic temperature and nuclear radiation. To study the nature of these effects, samples were exposed to an integrated fast neutron flux of about 2×10^{17} (E > .33 mev) nvt while being soaked in liquid hydrogen. After the radiation exposure the samples were subjected to tensile tests while being held at −423°F withoud intervening warmup. The alloys studied were 301 and 310 stainless steels cold rolled 60 and 75 percent respectively, 5 Al-2-1/2 Sn titanium(A110AT), and 2014-T6 aluminum. The tensile tests performed gave yield strength, tensile strength, elongation, notched tensile strength (K_t = 6.3), and the tensile strength of simple heliarc butt welded joints. Samples were tested in the unirradiated and irradiated conditions at both 70°F and −423°F. The largest and most consistent effect of cryogenic irradiation was a decrease in tensile strength and elongation after irradiation at −423°F. This effect varied from a 27% decrease in tensile strength for the 301 stainless steel to a 3% decrease for the 5 Al-2-1/2 Sn titanium. The effect of cryogenic irradiation was to severely restrict the amount of plastic deformation the samples could sustain after yield and prior to fracture. This phenomenon was in accordance with the theory that neutron radiation acts to introduce vacancies and interstitials which restrict the amount of plastic strain the samples can withstand before fracture. This effect was believed to be more severe at cryogenic temperatures because the neutron generated vacancies and interstitials can diffuse out at the higher temperatures, but are "frozen in" at cryogenic temperatures. Notched tensile tests showed that small amounts of embrittlement occurred in the 301 stainless steel after cryogenic irradiation, while the 310 stainless steel showed no embrittlement. It was believed that this condition resulted from the radiation induced embrittlement of the body centered martensite phase which constituted about 45% of the 301 stainless steel samples. The 5 Al-2-1/2 Sn titanium and the 2014-T6 aluminum alloys showed no embrittlement as a result of cryogenic irradiation. (auth)

13641 (NP-11570) MONTHLY ACCESSION LIST NO. 55 [ON RADIATION EFFECTS]. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Mar. 15, 1962. Contract AF33(616)-7375. 36p.

A bibliography of ~100 references, most with appended abstracts, is presented on radiation effects. The references are arranged under the following headings: Miscellaneous, and Inorganic Compounds, Electronics, Polymers, Metals and Ceramics, Dosimetry, Facilities, and Space. (D.L.C.)

13642 (ORNL-TM-132) DETERMINATION OF THE EFFECT OF NEUTRON IRRADIATION ON THE NIL-DUCTILITY-TRANSITION TEMPERATURE FOR TYPE A-212, GRADE B, STEEL USED IN THE N. S. SAVANNAH PRESSURE VESSEL. V. O. Haynes and W. C. Thurber (Oak Ridge National Lab., Tenn.). Mar. 21, 1962. Contract W-7405-Eng-26. 29p.

An accelerated dose-rate investigation was made to obtain information concerning neutron induced changes in the brittle-fracture properties of N. S. Savannah pressure-vessel steel. Charpy V-notch specimens were irradiated at about 500°F to fast-neutron doses (>1 Mev) of 4.4×10^{18}, 1.1×10^{19}, and 2.6×10^{19} neutrons-cm^{-2}. Subsequent examination of the impact energy characteristics of these specimens revealed that the 20 ft-lb transition temperatures had increased 90°F, 115°F, and 190°F, respectively, for these doses. (auth)

13643 (TID-14667) AN EXPERIMENTAL STUDY CONCERNING THE BASIC MECHANISM OF RADIATION DAMAGE. Annual Report. (Franklin Inst. Labs. for Research and Development, Philadelphia). Jan. 16, 1962. Contract AT(30-1)-2002. 62p.

With this is bound: DISLOCATION BEHAVIOR IN QUENCHED AND IN NEUTRON IRRADIATED STAINLESS STEEL. H. G. F. Wilsdorf (Franklin Inst. Labs. for Research and Development, Philadelphia) and D. Kuhlmann-Wilsdorf (Pennsylvania. Univ., Philadelphia. School of Metallurgical Engineering).

Investigation concerning the fundamentals of neutron irradiation damage in Cu, Ni, Mo, and Al-Mg alloys was continued during the year. The study was conducted by transmission electron microscopy of thinned-down irradiated material in strained and unstrained samples, and by dilatometric measurements of the permanent length changes in irradiated Cu single crystals after annealing. A paper on dislocation in quenched and in neutron irradiated stainless steel is included. It appears that radiation damage in this alloy consists of strong supersaturation of point defects, possibly in the form of some type of three dimensional aggregate, without associated stress field. Supersaturated point defects are also present to some extent in non-irradiated material. These lead to some climb in new dislocations in thin fails and probably to mushrooming in bulk materials. A summary of some lectures on radiation damage in metals given in Germany in Oct. 1961 is also included. (J.R.D.)

13644 (TID-15043) A CALORIMETRIC MEASUREMENT OF THE X-RAY PRODUCED STORED ENERGY IN SODIUM CHLORIDE (thesis). Fred Totten Phelps, Jr. (Nebraska. Univ., Lincoln). July 1961. Contract AT(11-1)-525. 152p.

Using a differential solution calorimeter, the x-ray-produced change in the heat of solution of NaCl was measured. Taking into consideration the chemical nature of the solution obtained when a colored crystal dissolves, the x-ray-produced stored energy was determined. In a coloration range from 2.5×10^{17} to 6.5×10^{17} F centers per cm^3

the total stored energy was found to be a linear function of the F center concentration with a slope of (10.3 ± 0.4) ev per F center and an intercept of (4.1 ± 1.5) × 10^{16} F centers per cm^3. If each M center is assumed to contribute approximately 10 ev to the stored energy and if all of the other higher order electron centers and hole centers are assumed to contribute negligible, the stored energy of an F center is found to be (9.8 ± 0.4) ev. Heat of solution measurements were performed with crystals which were first irradiated and then thermally bleached. From the mull results obtained as a result of the thermal bleaching it was concluded that x-ray irradiation of a NaCl crystal causes no more than a reversible reorientation of the crystal constituents. (auth)

13645 (TID-15230) RADIATION DAMAGE STUDIES IN SOLIDS USING THE TECHNIQUES OF ELECTRON-SPIN PARAMAGNETIC RESONANCE AND NUCLEAR MAGNETIC RESONANCE. Annual Progress Report. P. J. Bray, A. O. Williams, Jr., and H. O. Hooper (Brown Univ., Providence). Mar. 1, 1962. Contracts AT(30-1)-2024 and AT(30-1)-1880. 38p.

Nuclear magnetic resonance (NMR) studies and electron-spin paramagnetic resonance (ESR) studies were extended in neutron-irradiated LiF with particular attention devoted to the variation of the F-center resonance over the range of neutron doses 10^{16} to 10^{19} nvt and to an examination of the F^{19} molecular gas formation and sodium metal formation from NaF at large neutron doses. The normal F-center resonance is markedly altered by exchange narrowing when the spin concentration becomes sufficiently high. Measurements of line width and shape, spin-lattice relaxation, spin concentration, and thermal annealing effects are in support of this description of exchange narrowing of the F-center line. The presence of F gas was noted by NMR techniques and the properties of the F^{19} gas resonance were examined as a function of neutron dose. The presence of Na metal in NaF and of Ca metal in CaF_2 after heavy neutron irradiation was examined in an attempt to determine the mechanisms of metal formation. Final NMR and ESR measurements were made in KBr. Attempts were made to use the experimental data to determine the types and concentrations of the defects produced by neutron irradiation. Calculations of the electric field gradients produced by the defects in the KBr crystals are being carried out. The ESR spectra of atomic H and tritium in neutron-irradiated LiF single crystals which were annealed were examined at room and liquid N temperatures to determine the trapping sites for these atoms. The atomic H resonance was observed in annealed neutron-irradiated CaF_2. The ESR spectra observed in irradiated borate glasses were attributed to a hyperfine interaction of a hole with the B nucleus of a four-coordinated B atom. Investigations of irradiated alkali borate glasses enriched in B^{10} were carried out. ESR spectra were obtained from x ray and neutron-irradiated alumino-silicate glasses. Two types of resonances were observed in the x ray irradiated glasses. The first resonance was attributed to a hyperfine interaction of an unpaired spin with an Al^{27} nucleus of an Al atom bonded in a four-coordinated configuration. The second resonance was attributed to a hole associated with a non-bridging O. A third line observed in the neutron-irradiated glasses was identified as the resonance from trapped electrons in the SiO_2 network. (auth)

13646 (TIM-506) REMOTE DISASSEMBLY OF NUCLEAR DEVELOPMENT ASSOCIATES CAPSULES. C. E. Cunniff, Jr. (Pratt and Whitney Aircraft Div., United Aircraft Corp., [Hartford, Conn.]). May 23, 1957. Contract [AT(11-1)-229]. 12p

Postirradiation examination of NDA type capsules were performed. The operational procedure followed for disassembling a capsule containing sintered wafer assemblies is given. Modifications for disassembly of a 7-in KAPL type element capsule are discussed. Equipment adaptations are described. (M.C.G.)

13647 RADIATION EFFECTS IN INORGANIC SOLIDS. Discussions Faraday Soc., No. 31, 278p.(1961).

Twenty-six papers are included; separate abstracts have been prepared for twenty-two. Four papers were previously abstracted in NSA. Experimental and theoretical information on the radiation effects in metals, alloys, and nonmetallic solids are discussed. The conference was held at the Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France, on the 11th and 12th of April, 1961. (N.W.R.)

13648 ATOMIC COLLISIONS AND THE PROPERTIES OF DEFECTS IN METALS. W. M. Lomer (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Discussions Faraday Soc., No. 31, 24-8(1961).

Defects in metals are produced by direct collision processes. The elementary defects are vacancy, interstitial, and dislocation. The ease of formation and movement and the tendencies of coagulate and trap one another control the annealing behavior. The difficulty of making reliable numerical estimates of these quantities is discussed. The attempts at calculation of the properties of these defects is outlined and compared with experiment. New ideas on the kinetics of collision processes are also briefly outlined. (auth)

13649 CLUSTERS OF POINT DEFECTS IN IRRADIATED METALS. R. S. Barnes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Discussions Faraday Soc., No. 31, 38-44(1961).

Small vacancy clusters were observed in metals quenched from high temperatures and in irradiated metals. Electron microscopic observations show that near point-defect sinks, clusters may not form but elsewhere they are of two types. The large and less numerous clusters are thought to be formed from interstitial atoms and the others from vacancies. The large clusters anneal out at about the self-diffusion temperature but their behavior is markedly different if the metal is deficient in vacancies. The form and crystallography of these two types of cluster and the manner of their formation, growth, and interaction are discussed, together with their influence upon the physical properties. (auth)

13650 MAGNETIC METHODS FOR STUDYING RADIATION DAMAGE IN FERROMAGNETIC SUBSTANCES. D. Dautreppe, P. Moser, and J. Pauleve (Centre d'Etudes Nucleaires, Grenoble, France). Discussions Faraday Soc., No. 31, 53-6(1961).

The measurements of magnetic after-effects on irradiated iron point to the presence of three families of defects: after 25°C irradiation, the first one has a mean activation energy of 1.2 ev; after 78°K irradiation, the second and third one have respectively 0.3 and 0.6 ev. The irradiation in a magnetic field of a 50% iron + nickel alloy, make possible the very sensitive study of diffusion phenomena through ordering. (auth)

13651 ENERGY DEPENDENCE OF ELECTRON-INDUCED ATOMIC DISPLACEMENTS IN Al, Ag, Cu, Fe, AND Ni. P. G. Lucasson and R. M. Walker (General Electric Research Lab., Schenectady, N. Y.). Discussions Faraday Soc., No. 31, 57-66(1961).

The variation of the cross-section for atomic displace-

ment, $\sigma_d(E)$, was measured as a function of bombarding electron energy in the range from 0.5 to 1.3 Mev for Cu, Fe, Ni, Ag, and Al. The $\sigma_d(E)$ curve for copper agrees with previous measurements, but appears to disagree with the machine calculations of the Brookhaven group. For Cu, Ni, and Fe, the results, coupled with previous neutron damage data, suggest that the basic damage processes are equivalent both for low- and high-recoil energies. The Ag results confirm directly that the threshold energy increases with increasing atomic number in the series Cu, Ag, and Au. All the $\sigma_d(E)$ data with the exception of Al can be fit with curves calculated from simple threshold functions. The following values of effective threshold energy are found: Cu, 22 ev; Ag, 28 ev; Ni, 24 ev; and Fe, 24 ev. The corresponding approximate values for the resistivities of Frenkel pairs, $\Delta_{\rho f}$, are: Cu, 1.3 μohm cm/at. %; Ag, 1.4 μohm cm/at. %; Ni, 3.2 μohm cm/at. %; and Fe, 12.5 μohm cm/at. %. The $\sigma_d(E)$ data for Al do not fit curves calculated from simple threshold functions and this is interpreted as evidence for multiple defect production in the range of bombarding energies used. (auth)

13652 VACANCY ENHANCED DIFFUSION IN SILICON. EFFECTS OF IRRADIATION AND OF CHEMICAL IMPURITIES. P. Baruch (Ecole Normale Supérieure, Paris), C. Constantin, J. C. Pfister, and R. Saintesprit. Discussions Faraday Soc., No. 31, 76-85(1961).

In silicon, the diffusion of most electrically active impurities is caused by a vacancy mechanism and by the introduction of excess vacancies created by irradiation. To observe this effect, wafers of n-type silicon containing a p—n junction at 6 μ from the surface are bombarded with 275 kev protons. This junction was obtained through gallium diffusion. The bombardment temperature was between 900 and 1100°C. It is observed that, in the irradiated region, the junction depth increases. Thus, the gallium has diffused inwards the crystal at a larger rate than in the non-irradiated region. However, since the penetration of 275 kev protons in silicon is only 3 μ, one must suppose that vacancies diffuse, after being created over a few microns, to enhance gallium diffusion at the junction location. Other explanations are possible, such as the effect of hydrogen injected by the proton beam, or the effect of thermal stresses. The observed advance of the diffusion front in these experiments is similar to the advance of the collector junction below the emitter in the fabrication of double-diffused silicon transistors by the oxide masking-technique. A possible explanation would follow the same lines; the introduction of donors, to form the emitter, increases the local vacancy concentration, by ionization interaction. These vacancies would enhance the acceptor diffusion rate. These effects can be used to obtain information relative to the concentration of thermal vacancies and to the diffusion length, lifetime, and annihilation mechanism of excess vacancies. (auth)

13653 ELECTRON PARAMAGNETIC RESONANCE OF DEFECTS IN IRRADIATED SILICON. G. D. Watkins and J. W. Corbett (General Electric Research Lab., Schenectady, N. Y.). Discussions Faraday Soc., No. 31, 86-95(1961).

Five of the dominant electron paramagnetic resonance spectra found in silicon irradiated at room temperature by 1.5 Mev electrons are discussed. Each spectrum is interpreted as due to a resonance electron in a broken-bond orbital such as may be associated with a lattice vacancy. Two of the spectra are found to be due to vacancy-impurity atom pairs. Two other spectra are tentatively assigned to differing charge states of the same defect, the divacancy. Electrical levels are associated with these defects. It is argued that the activation energies for motion of the vacancy and divacancy are ~0.4 and ~1.3 ev respectively, and that the binding energy for the divacancy is >1.5 ev. The possible role of the interstitial is discussed. (auth)

13654 OPTICAL AND ELECTRICAL EFFECTS OF RADIATION DAMAGE IN DIAMOND. C. D. Clark, P. J. Kemmey, and E. W. J. Mitchell (Univ. of Reading, Eng.). Discussions Faraday Soc., No. 31, 96-106(1961).

Measurements were made of the optical absorption induced in diamond by irradiation with electrons of energy in the range 0.3 to 2.0 Mev. Rate curves were determined for various features in the absorption spectrum. Electron irradiation of semiconducting diamond causes a decrease in the resistivity, most of which arises from a decrease in the carrier concentration. The shape of the rate curve of carrier concentration as a function of dose can be satisfactorily explained in terms of radiation-induced donor levels. The variation with electron energy of the rate of introduction of the donor levels was also determined. Both optical and electrical rate curves are compared with calculated curves for the displacement of atoms, assuming various values of the displacement energy. Up to 1.0 Mev, the optical results have similar shape to the curve calculated for $E_d = 80$ ev and the calculated number of defects deduced is in reasonable agreement with the concentration of donor levels from the electrical measurements. (auth)

13655 CARRIER RECOMBINATION AND TRAPPING PROCESSES IN IRRADIATED GERMANIUM. O. L. Curtis, Jr. and J. H. Crawford, Jr. (Oak Ridge National Lab., Tenn.). Discussions Faraday Soc., No. 31, 107-17 (1961).

An investigation was made of the carrier-recombination process in irradiated germanium. In order to analyze the recombination behavior it was necessary to treat the problem of recombination in the presence of trapping. A model which explains the experimental results in n-type material for various sorts of irradiation is presented. On the basis of this model, recombination occurs at an energy level 0.36 ev above the valence band in gamma-irradiated germanium. The position of this level is shifted slightly downward for neutron-irradiated material. Trapping levels which are not present in antimony-doped material occur in arsenic-doped germanium 0.17 ev above the valence band. (auth)

13656 RADIATION EFFECTS IN FUSED SILICA AND α-Al_2O_3. W. Dale Compton and George W. Arnold, Jr. (U. S. Naval Research Lab., Washington, D. C.). Discussions Faraday Soc., No. 31, 130-9(1961).

A study of the mechanism of defect formation was made in fused silica and in α-Al_2O_3. Low-energy ionization processes are shown to generate defects in the fused silica. The rate of defect formation is found to be strongly dependent upon the temperature of irradiation. Lattice defects cannot be generated in α-Al_2O_3 by low-energy ionization processes. It is shown that fast electrons with energy less than 0.37 Mev cannot generate the lattice defects responsible for the optical absorption band at 205 mμ. A comparison of the magnitude of the absorption band with the computed number of displacements makes it possible to determine an oscillator strength for this band. (auth)

13657 ELECTRON SPIN RESONANCE STUDIES ON RADIATION EFFECTS IN INORGANIC SOLIDS. John E. Wertz, John W. Orton, and Peteris Auzins (Univ. of

Minnesota, Minneapolis). Discussions Faraday Soc., No. 31, 140-5(1961).

Defects induced in magnesium oxide by neutron irradiation are largely the result of atom displacements. The vacancies which are left behind are sites at which either electrons or holes may be trapped, depending upon the sign of the displaced ion. Such bound electrons or holes are paramagnetic entities which may give rise to ESR absorption. Thus, negative-ion vacancies in three different environments are trapping sites for electrons, and positive-ion vacancies of two types are trapping sites for holes. These two hole centres are in addition to those types found in crystals which were not neutron-irradiated. Some of these centres may be induced by grinding and x irradiation of MgO or other alkaline earth oxides, sulfides or selenides which have the MgO structure. Mechanical working is believed to distribute negative-ion vacancies by dissociation from dislocations which are swept through the crystals. In the neutron-irradiated crystals, there is evidence that some local regions are so disrupted that they rearrange to body-centred instead of face-centred packing. Extended heating largely anneals out the neutron-produced structural defects. One is then enabled to see ESR spectra of defects which are highly sensitive to distortions of cubic symmetry. (auth)

13658 THE FORMATION OF INTERSTITIALS AND VACANCIES IN ALKALI HALIDES. R. Smoluchowski (Princeton Univ., N. J.) and D. A. Wiegand. Discussions Faraday Soc., No. 31, 151-5(1961).

Alkali halide crystals were x-irradiated under a variety of conditions and the volume expansion and optical absorption studied. At low temperatures both LiF and NaCl were found to expand on irradiation. However, on warming to room temperature, at least two stages of annealing are observed for LiF, while none were found for NaCl. LiF also differs appreciably from KCl and NaCl in the dependence of F-centre formation at room temperature on intensity of irradiation and sensitivity to plastic deformation. It can be deduced from these results that similar defects may not be generated in all alkali halides in significant densities by x irradiation and that more than one mechanism of defect generation may be important. A possible mechanism of defect generation is considered in which halogen vacancy-interstitial pairs are produced by multiple ionization. The collision of, for example, a Cl^+ with a Cl^- leads to the formation of a $Cl^+ Cl^-$ molecule. By a de-excitation exchange, the electronic energy of this state is converted into several ev of repulsive kinetic energy. This kinetic energy is sufficient to form, possibly with the help of focused collisions, a halogen vacancy and an interstitial separated by many lattice parameters. The efficiency of multiple ionization by Auger effect is estimated for KCl and found to be consistent with the reported F-centre formation rate at low temperatures. (auth)

13659 ROLE OF THE AUGER EFFECT IN THE DISPLACEMENT OF ATOMS IN SOLIDS BY IONIZING RADIATION. J. Durup and R. L. Platzman (Faculté des Sciences, Paris). Discussions Faraday Soc., No. 31, 156-66(1961).

An atom may be displaced in a solid by a mechanism comprising two consecutive steps: an initial, purely electronic excitation by ionizing radiation of an atom or group of atoms, and a subsequent reorganization of atomic positions in the modified electronic field. A general discussion is given of this class of mechanisms, and of an important instance, atomic reorganization following ejection by an energetic charged particle of an inner atomic electron, with immediate resultant Auger cascade. A method for theoretical calculation of the absolute yield of such primary processes is developed, and numerical results are presented for ejection of inner electrons in LiF and KCl crystals during complete absorption of mono-energetic incident electrons having initial kinetic energies between 1 kev and 4 Mev. For all except the most lightly bound electron shells, the yield increases with increasing electron energy. For intermediate shells the yields are high enough, and the activation of the medium great enough, to be comparable to experimentally observed effects. (auth)

13660 INFLUENCE OF RADIATIONS OF THE ELECTRICAL AND OPTICAL PROPERTIES OF LiF. M. Dubois, P. Bergé, and G. Blanc (Centre d'Etudes Nucleaires, Saclay, France). Discussions Faraday Soc., No. 31, 167-75(1961).

Unirradiated single crystals show at room temperature an ohmic conductivity of about $10^{-15}\Omega^{-1}cm^{-1}$. The slope of the log σ against 1/T curve decreases continuously from 1.1 ± 0.05 ev between 10 and 50°C, to 0.7 ev slightly below the intrinsic range. This behavior may be ascribed to a quasi-chemical equilibrium: $Mg^{2+}\,\boxed{Li} \rightleftharpoons Mg^{2+} + \boxed{Li}$. The binding energy between the divalent impurity and its positive induced vacancy is 0.7 ± 0.05 ev. By γ irradiation the conductivity is reduced by a factor up to 10^3 with formation of the conventional F, M, and R optical absorption bands. The thermal annealing of this electrical property proceeds continuously between 90 to ~400°C, with a strong thermoluminescence effect, to complete recovery. There is no apparent kinetics and it appears that the same process anneals the defects introduced by irradiation and simultaneously promotes conduction. A short exposure to radiations from a reactor (γ rays and thermal neutron) brings about a similar decrease of conductivity. However, for larger doses, σ increases again and can even exceed the unirradiated value. Thermal annealing shows two ranges of recovery. In the first, around 350°, there is a decrease of conductivity, and in the second, between 400 and 450°, an increase up to complete electrical recovery. The behavior during both irradiation and thermal annealing is highly sensitive to divalent impurities content; this allows an analysis of the reactor irradiation effects according to a double mechanism: the first extrinsic, annihilation of divalent-impurities induced carriers and a second, intrinsic, creation of new carriers. For doses where last effect is predominant, there appears a new optical absorption band at 5230 Å with a broadening of the M band. The correlation of annealing between various properties allows their assignment to impurities or to intrinsic effects. (auth)

13661 ROLE OF IMPURITIES IN RADIATION EFFECTS IN IONIC SOLIDS. E. E. Schneider (Kings Coll., Newcastle-upon-Tyne, Eng.). Discussions Faraday Soc., No. 31, 176-83(1961).

Radioinduced centers associated with heterovalent and homovalent impurities in alkali halide and magnesium oxide crystals are discussed in terms of a principle of extended charge compensation. The primary process in the initial, fast, stage of the x-ray coloration of nominally pure or deliberately doped alkali halides is the formation of such centers by the trapping of positive holes and the consequent creation of negative-ion vacancies. This is supported by experimental results on crystals of KCl–Sr, NaCl–Mn, and LiF–Na, in which the amount of impurity actually in solid solution was determined by ionic conductivity measurements or electron spin resonance ob-

servations. Experimental evidence is presented to support the claim that partially dissolved impurities and the associated substructure of precipitates and dislocations play an equally decisive role in the second, slow, stage of x-ray coloration at normal temperatures. (auth)

13662 THERMAL BLEACHING OF V- AND F-CENTERS IN X-IRRADIATED POTASSIUM CHLORIDE CRYSTALS. J. Z. Damm and F. C. Tompkins (Imperial Coll. of Science and Tech., London). Discussions Faraday Soc., No. 31, 184-92(1961).

The kinetics of thermal bleaching at 25°C of V- and F-centers were studied in four different single potassium chloride crystals, of varying divalent cation impurity content, that were colored by x irradiation. The V-band comprises both V_2-centers, which undergo bleaching and V_3-centers that are stable at 25°C. The maximum number of V_2 centers is rapidly attained under irradiation and is dependent on the cationic impurity content; V_3-centers are created at a slower rate, and the number formed is related to the dislocation density of the crystal. The bleaching of V_2-centers results from the thermal excitation of F-centers and the capture of F-electrons by the V_2-center, the kinetics being accurately represented over the whole range of measurements by a bimolecular process. There remains, however, apparently a residual concentration of V_2-centers after the virtual completion of the bleaching process; some possible explanations of this anomaly are suggested. (auth)

13663 ANNEALING OF RADIOLYTIC DAMAGE IN SOME NITRATES. PART I. LEAD NITRATE. A. G. Maddock and S. R. Mohanty (University Chemical Lab., Cambridge, Eng.). Discussions Faraday Soc., No. 31, 193-202(1961).

A kinetic study of the reformation of nitrate from the radiolysis products in irradiated crystalline lead nitrate is presented. The data can be interpreted in terms of a unimolecular recombination, affecting a proportion of the fragments and a bimolecular process, with a higher energy of activation, governing the behavior of the remainder. Some alternative mechanisms are also considered and an interpretation of the above, preferred, mechanism is given. Annealing of photolytic damage in the same material is also reported. (auth)

13664 RADIATION-INDUCED PROCESSES ON THE SILICA-GEL SURFACE. V. B. Kazansky, G. B. Parlisky, and V. V. Voevodsky (Inst. of Chemical Physics, Academy of Sciences, Moscow). Discussions Faraday Soc., No. 31, 203-8(1961).

Thermally pre-treated silica-gel samples were irradiated in vacuum by gamma-rays from a Co^{60} source, and investigated by the electron spin resonance (ESR) method. Scission of bonds in surface OH groups of silica-gel, leading to formation of hydrogen atoms stabilized in the surface layer, was shown to take place in samples irradiated at the liquid-nitrogen temperature. Adsorbed hydrogen atoms were highly reactive and interacted chemically with oxygen and ethylene at −150 and −120°C. An ethyl radical spectrum was observed in the latter case. The hydrogen-atom signal from samples irradiated at the liquid-nitrogen temperature was accompanied by a complex signal caused by silica-gel defects and consisting of at least four different superimposed lines. The formation of F-centers in samples irradiated at room temperature took place on the surface and in the bulk of silica-gel. Very weak lines of a hyperfine structure, possibly connected with hyperfine splitting due to interaction of odd electrons with hydrogen atoms of surface hydroxyl groups were also observed. An asymmetric line probably caused by the formation of surface peroxide radicals appeared in the spectrum under the action of oxygen. Since the intensity of this signal was much higher than that shown initially by the irradiated silica-gel, it may be inferred that not all the defects formed during irradiation may be detected by the ESR technique. Interactions between radiation-induced silica-gel defects and various gases were studied. The results are of interest in connection with the increased catalytic activity of irradiated silica-gel, as observed by Cohn and Taylor. (auth)

13665 EFFECT OF IONIZING RADIATION ON THE ADSORPTIVE AND CATALYTIC PROPERTIES OF SEMICONDUCTORS. Th. Wolkenstein (Academy of Sciences Moscow). Discussions Faraday Soc., No. 31, 209-18(1961).

The effect of ionizing radiation on the adsorptive and catalytic properties of a semiconductor is formulated from the electron theory of chemisorption and catalysis. An analysis is given of the mechanism by which irradiation affects adsorption equilibrium, adsorption kinetics, and the rate of the catalytic reaction. The dependence of the irradiation effect upon temperature, pressure, and the biography of the sample is considered. (auth)

13666 γ-IRRADIATION OF ZINC OXIDE AND ITS EFFECT ON ADSORBED LAYERS. T. I. Barry and K. Klier (Wantage Research Lab., Berks, Eng.). Discussions Faraday Soc., No. 31, 219-28(1961).

An apparatus is described for measuring the electrical conductivity of powdered zinc oxide with simultaneous measurements of adsorption and desorption of gases. These measurements yield information on charge transfer during reversible and irreversible adsorption. Hydrogen irreversibly chemisorbed at 0°C acts as an efficient trap for positive holes during irradiation and this leads to an enhancement of the radiation-induced conductivity and to a change in the nature of the adsorbed hydrogen. Isobutene behaves similarly. Oxygen preadsorbed at coverages above a critical value can be desorbed by irradiation of zinc oxide; at the same time the remaining adsorbed oxygen acts as a trap for electrons and this causes a negative trend in the radiation-induced conductivity. (auth)

13667 THE EFFECT OF REACTOR IRRADIATION ON THE THERMAL DECOMPOSITION OF SILVER OXALATE. R. H. Haynes and D. A. Young (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Discussions Faraday Soc., No. 31, 229-37(1961).

The effects of pre-irradiation with reactor radiation and γ-rays on the thermal decomposition at 126°C was studied. Once the conditions necessary for reproducible behavior were established, it was found that the decomposition of unirradiated material accelerated according to an exponential law and decayed according to the contracting-sphere concept, whereas irradiated material accelerated according to a cube law with more complicated kinetics during the decay period. A tentative interpretation of both the reproducible and the irreproducible behavior observed is given. Kinetic analysis by translation and transformation leading to superimposition on reduced plots was used extensively. (auth)

13668 RADIATION-INDUCED DECOMPOSITION OF INORGANIC NITRATES. Everett R. Johnson and Jeremy Forten (Stevens Inst. of Tech., Hoboken, N. J.). Discussions Faraday Soc., No. 31, 238-46(1961).

The mechanism for the decomposition of the nitrates is complex and appears to depend on the relative importance of the reactions $NO_3^- + O \rightarrow NO_2^- + O_2$ and $NO_2^- + O \rightarrow NO_3^-$. Lattice changes that occur during irradiation affect the

relative importance of these reactions in the decompositions. (auth)

13669 CHEMICAL DECOMPOSITION OF CRYSTALS OF LEAD IODIDE BY IRRADIATION IN AN ELECTRON BEAM. A. J. Forty (Bristol Univ., Eng.). Discussions Faraday Soc., No. 31, 247-53(1961).

Thin crystals of lead iodide decompose in the beam of an electron microscope. The decomposition was studied continuously by direct observation and by electron diffraction, for both low and high intensities of irradiation. The sequence of events follows a definite pattern, from a preliminary rearrangement of the microstructure, through an intermediate stage in which cavities are created inside the crystal, to the final stage in which metallic lead begins to precipitate. Cavity formation appears to be an important step toward final decomposition. The way in which cavities are formed by electron irradiation is not fully understood, but some tentative ideas, based on an ionization process, are put forward for discussion. (auth)

13670 STORED ENERGY IN GRAPHITE AND REACTOR DESIGN. H. Bridge, B. T. Kelly, and B. S. Gray (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). Nuclear Eng., 7: No. 70, 91-6(Mar. 1962).

Research into the behavior of graphite when subjected to radiation at various temperatures is complicated by the need to accelerate irradiation tests. Conclusive techniques were devised. The experimental results and theoretical extrapolation methods upon which the latest British civil stations are designed are summarized. (auth)

13671 PHOTOCONDUCTIVITY AND INFRA-RED ABSORPTION IN SILICON IRRADIATED BY NEUTRONS. V. S. Vavilov, E. N. Lotkova, and A. F. Plotnikov (Lebedev Inst. of Physics, Moscow). Phys. and Chem. Solids, 22: 31-8(Dec. 1961). (In English)

The infrared absorption and photoconductivity of silicon single crystals irradiated by neutrons were investigated in p-type samples. Absorption bands at 1.8, 4.1, 5.9 μ and weaker bands at 3.5 and 3.7 μ were found. In n-type silicon a band was observed near 1.8 μ along with a band near 3.7 μ which at low temperature was resolved into two at 3.5 and 3.7 μ, and a band at 5.5 μ. The photoconductivity spectra in p-type crystals correspond to energy levels situated at 100°K near $E_v + 0.3$ ev (4.1 μ), $E_v + 0.33$ ev (3.8 μ), $E_v + 0.38$ ev (3.3 μ), and $E_v + 0.45$ ev (2.8 μ) and two levels in the upper part of the forbidden gap: $E_c - 0.4$ ev (1.62 μ) and $E_c - 0.16$ ev (1.23 μ). The investigation of the kinetics of photoconductivity made it possible to determine the hole capture cross-section for some of the radiation defects, energy levels. (auth)

13672 HOLE PHOTOCONDUCTIVITY IN KBr CRYSTALS CONTAINING Br^- MOLECULE IONS. C. J. Delbecq (Argonne National Lab., Ill.). Phys. and Chem. Solids, 22: 323-5(Dec. 1961).

After x irradiation at liquid nitrogen temperature, holes are trapped by forming Br_2^- molecule ions in KBr containing one of the impurities Ag^+, Tl^+, Pb^{2+}, or NO_2^-. The Br_2^- molecule ions are oriented along ⟨110⟩ directions in the crystal and have two principal absorption bands at 385 mμ and 750 mμ, both of which show anisotropic properties. Irradiation into either one of these bands with [0$\bar{1}$1] polarized light causes a redistribution of the ions among the six ⟨110⟩ directions in the crystal so that the population in [011] is considerably enhanced. Photoconductivity was observed upon bleaching with light of 750 mμ wavelength. The bleaching light used was polarized along either [0$\bar{1}$1] or [011]. Since continued bleaching at 750 mμ with [0$\bar{1}$1] light causes a decrease in the absorption of [0$\bar{1}$1] light, the observed photoconductivity decreases. If the plane of polarization of the bleaching light is rotated to [011], the photoconductivity rises and then decays to an equilibrium value. These changes in photoconductivity were correlated with changes produced in the optical absorption spectra of Br_2^-. (auth)

13673 EFFECT OF RADIATION AND MOISTURE ON THE DYNAMIC MECHANICAL PROPERTIES OF POLYETHYLENE TEREPHTHALATE. D. E. Kline and J. A. Sauer (Pennsylvania State Univ., University Park). Polymer, 2: 401-7(Dec. 1961).

Studies of effects of nuclear radiation on the dynamic mechanical properties of a series of polyethylene terephthalate specimens are reported. The investigations cover a temperature range from 80 to 530°K and a frequency range from about 100 to 1300 cycles/sec. Radiation doses greater than 10^9 rads significantly decrease the temperature of the main glass transition and cause other changes in the internal friction spectra. Addition of water also causes a shift of the glass transition to lower temperatures. (auth)

13674 A STUDY OF IMPURITY PHOTOCONDUCTIVITY IN GERMANIUM IRRADIATED BY γ-RAYS. S. M. Ryvkin, R. Yu. Khansevarov, and I. D. Yaroshetskii (Inst. of Physics and Tech., Leningrad). Soviet Phys.-Solid State, 3: 2331-6(Apr. 1962).

Impurity photoconductivity in n-type germanium subjected to γ radiation was investigated. The existence of two independent levels for the radiation defects at $E_c - 0.2$ ev and $E_v + 0.26$ ev was established from the shape of the spectral dependence of the impurity photoconductivity. The kinetics of the impurity photoconductivity was investigated and the parameters of the level at $E_c - 0.2$ ev were determined. The complicated effects associated with the onset and decay (quenching) of photoconductivity, which are observed under combined excitation, are explained from a unified point of view. (auth)

13675 IONIZING RADIATION INDUCED PHYSICAL PROCESSES IN ALKALI HALIDE CRYSTALS. I. CREATION OF COLOR CENTERS IN NaCl SINGLE CRYSTALS. M. A. Elango. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 17, 135-47(1961). (In Russian)

A comparative investigation was made of growth curves of x-ray induced F- and V_2-centers and thermal bleaching curves of F-centers in NaCl single crystals containing a different number of host and impurity defects. It was established that the x-ray induced growth of the number of electronic (F) and hole (V_2) centers occurs in two stages. The first rapid stage depends on the pre-excitation number of vacancies in the crystal, the second, linear stage depends on the degree of the plastical deformation of the crystal. The ratio of the number of V_2-centers to F-centers increases with excitation time. It was found that the greater the pre-excitation point defect number in the crystal, the lower is the thermal stability of the X-created F-centers in it. This effect is connected with the ionic mechanism of the thermal destruction of color centers. The mechanism of the creation of color centers by x-rays is discussed. (auth)

PHYSICS

General and Miscellaneous

13676 (AD-260368) OPTIMIZATION OF THERMOELECTRIC ENERGY CONVERTERS. Bimonthly Progress Report No. 2, June 15, 1960 through August 14, 1960. Philipp H. Klein, ed. (General Electric Co. Aircraft Accessory Turbine Dept., Lynn, Mass.; General Electric Co. General Engineering Lab., Schenectady, N. Y., and General Electric Co. Electronics Lab., Syracuse, N. Y.). Contract NObs-78403. 54p.

A preliminary analysis of the first thermal system to be investigated was nearly completed. This system consists of saturated steam at 533°K (500°F), a thermoelectric generator utilizing thermoelectric materials representative of the present state of the art, and a sea-water heat sink at 291°K (65°F). Leakage of heat through the thermal insulation was taken into account in the calculations, as were other factors, such as contact resistance, the dimensions of the container of the generator, and the dimensions of the conductors connecting the individual arms. The effects of variation of these parameters on the power output per unit weight, volume, and area of the system are graphically portrayed. The results for cooling by free convection of the sea-water coolant, together with preliminary results for the forced-convection case are presented. A magnesia-titania ceramic body was tested and found to be a material suitable as a high-temperature encapsulating medium in conjunction with iron end-caps. Because its coefficient of thermal expansion more closely approximates that of iron than does forsterite, the new material may permit reduction of the wall-thickness of tubing used for encapsulation of thermoelectric materials, effecting a marked diminution in thermal losses through the encapsulant. Improvements in sealing technology include the construction of an improved sealing apparatus and its use for closing an easily-filled cell that will facilitate the study of thermoelectric properties of encapsulated materials. Encapsulation of p-type lead telluride was successfully accomplished, although further study is required in order to make the procedure completely reliable. Preliminary batches of Mg_3Sb_2 were prepared in an inert-atmosphere furnace designed for operation at temperature up to 1400°C. It appeared that problems arising from reaction of the constitutents with the container can be solved by use of a molybdenum vessel with a split-crucible design. A versatile zone-refining apparatus for purification of lithium was constructed and tested. Infrared reflectance measurements on a specimen of CrSb indicated that its absorption edge lies in the 14-micron range, suggesting a lower band-gap energy than initially expected. If this conclusion is verified by thermal measurements, it will be necessary to alloy the compound with large-gap materials in order to produce an alloy with optimum properties at elevated temperatures. Leakage in a tantalum-lined iron bomb precluded the successful preparation of samples of Ca_2Pb and Ca_2Sn. A welded vessel, made entirely of tantalum, was designed in an effort to solve the problems arising from the volatility and corrosive nature of the calcium. (auth)

13677 (AFCRL-268) REFLECTION AND REFRACTION OF WEAK HYDROMAGNETIC DISCONTINUITIES. Jack Bazar (New York Univ., New York. Inst. of Mathematical Sciences). Feb. 1961. Contract AF 19(604)-6144. 69p. (MH-11; AD-259342)

The reflection and refraction of weak hydromagnetic disturbances at surfaces of discontinuity in a medium is studied. It is shown that the introduction of an appropriate set of direction angles for the unperturbed magnetic field on each side of the discontinuity makes possible both a simplification of laws relating to the reflection and refraction of Alfvén waves, and a simple graphical method for determining the real angles and speeds at which the reflected and refracted waves emerge. The relationship of the graphical procedure to Huygens' construction is discussed. Application of the theory is made to several two-dimensional steady-flow problems and to the problems of reflection and refraction at a rigid infinite conductor and at a contact discontinuity. (auth)

13678 (AFCRL-401) CROSSED-FIELD THERMIONIC CONVERSION. Scientific Report No. 10. P. H. Peters (General Electric Co. Research Lab., Schenectady, N. Y.). Mar. 1961. Contract AF 19(604)-5472. 34p. (AD-260356)

A thermionic energy converter having three electrodes, an emitter, a collector, and a beam-forming anode is studied, which uses an electron beam of the crossed-field type. The electric field above the emitter is created by an auxiliary voltage source. This voltage may be made as high as is necessary to accelerate electrons from the emitter surface. The emitter-anode spacing may be larger than that of a vacuum diode converter. Generated power is derived from electron flow across the emitter-collector contact potential. Measurements of the effects of applied voltage and magnetic field on anode and collector currents are made in a planar geometry. (auth)

13679 (AFOSR-825) THE ELECTRICAL PROPERTIES OF IONIZED FLAMES. PART I. STUDY OF FLAME IONIZATION. Thomas H. Dimmock and W. R. Kineyko (Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.). Aug. 1961. Contract AF49(638)-305. 33p. (AD-262367)

The concentration and distribution of the ions in high-temperature flames enriched with easily ionized additives was determined. Ionization densities up to $10^{14}/cm^3$ were measured by Langmuir probes. Other methods of measuring flame ionization, such as double probes and microwave attenuation, were employed and corroborated single-probe measurements. For these tests, hydrogen flames were burned with both oxygen and nitric oxide. Measurements of ionization in the H_2-O_2 flames reached $10^{14}/cm^3$ and agreed with theoretical values. Measurements in the H_2-NO flame never surpassed $10^{13}/cm^3$ and were found to depend critically upon propellant flow rate and burner geometry. A large cold gas boundary layer existing in the nitric oxide flames formed a thermal barrier to the passage of electrons from the burner into the flame and affected probe measurements. (auth)

13680 (AFOSR-2259) STUDIES OF OPTICAL POLARIZATION BY ELECTRON IMPACT. Technical Report. R. H. Hughes and O. H. Zinke (Arkansas. Univ., Fayetteville). Dec. 1961. Contract AF 49(638)-559. 55p.

An investigation of the polarization of the atomic line radiation induced by electron impact on helium was undertaken. Experimental data were obtained on the polarization of several lines as a function of both electron energy and pressure. Secondary excitation processes, such as collision of the second kind and radiative transfer (cascade),

were found to play an important role in the polarization. An expression was derived which enables the measurement of gas-kinetic collision cross sections involving atoms in excited states by observing the depolarization as the gas pressure increases. Such cross sections were determined for some states. The feasibility of the detection of the Lyman alpha radiation from positronium formed through the charge-changing collisions between positrons and gas atoms, was investigated. Excitation of nitrogen and rare-gas atoms by beta emission from W^{185} was observed. (auth)

13681 (AI-6799) FIRST SUMMARY REPORT OF BASIC RESEARCH IN THERMIONIC ENERGY CONVERSION PROCESSES. Ned S. Rasor, ed. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 15, 1961. Contract Nonr-3192(00). 241p.

Incentives for achieving a thermionic nuclear power plant for naval applications are briefly reviewed, and the associated thermionic energy conversion processes chosen for basic study are qualified and summarized. The results and status of these basic investigations are reported under the following topics: emission limitations on thermionic energy conversion; correlation of electron, ion, and atom emission energies; potential of an ion in a discrete dipole layer; statistical mechanical treatment of surface ionization; an experimental search for an elemental surface exhibiting low electron work function; Cs–O–H–Mo system interactions and transfer of molybdenum within a thermionic diode; analysis of the space charge mode in the cesium thermionic diode; analysis of the plasma mode in the cesium thermionic diode; plasma mode in a thermionic diode with detailed energy balance; plasma resistivity and collective interactions; instabilities in high current discharges in cesium vapor; and influence of ion motions on nonlinear plasma oscillations.

13682 (ANL-6483) SOME ASPECTS OF THE APPLICATION OF NUCLEAR ENERGY TO SMALL PORTABLE AND AUTOMOTIVE POWER SUPPLIES. D. R. MacFarlane (Argonne National Lab., Ill.). Feb. 1962. Contract W-31-109-Eng-38. 38p.

The problem of applying nuclear energy to segments of the United States economy other than central station electric power, specifically to small portable power supplies used for transportation purposes, is treated. A survey of various energy conversion devices suitable for use in mobile power units is presented. Included also is a comparison of a number of energy source-converter combinations for application as portable power units. It is concluded that storage of nuclear energy in chemical fuels is the only feasible way of approaching the performance of present day, internal combustion engines with hydrocarbon fuels in a future system dependent totally on nuclear energy. A preliminary survey of likely chemicals fuels for such a nuclear-chemical energy distribution system is presented. Materials which approach hydrocarbons on an energy density basis are light elements in the first three periods of the periodic table having atomic weights below about 40. With this criterion and based on cost, availability and ease of handling, magnesium, aluminum, and silicon are materials which look attractive as mass quantity fuels for a nuclear-chemical energy cycle. Some discussion of the fuel processing cycles and possible types of converters for these fuels is also included. (auth)

13683 (AROD-2211.3) LOW ENERGY NUCLEAR AND ELECTRON PHYSICS. Final Report, November 1, 1958 through October 31, 1961. L. A. Page, F. E. Obenshain, J. E. Brimhall, and A. L. Tamburrino (Pittsburgh. Univ. Sarah Mellon Scaife Radiation Lab.). Contract DA-36-034-2765. 88p.

The effects of strong electric and magnetic fields on positronium formation and annihilation in gases (e.g., O_2, Ar, N_2, Ar–N_2, Ar–O_2, and SF_6) are studied, by examining the positronium annihilation photons. Asymmetric effects observed upon reversing the electric field are investigated. In addition, a method is described for analyzing the electron spin characteristics of ferromagnets by Compton scattering of circularly polarized photons. An apparatus is described for measuring the plane polarization of γ rays by Compton scattering in a ring geometry, or by two successive Compton scatterings. (T.F.H.)

13684 (ASD-TDR-62-39) GENERATION OF COHERENT ELECTROMAGNETIC SIGNAL IN THE LOW AND SUBMILLIMETER RANGE. Technical Note No. 2. Basil W. Hakki (Illinois. Univ., Urbana. Electrical Engineering Research Lab.). Dec. 1961. Contract AF33(616)-7043. 55p.

Three schemes were studied as a means of generating coherent electromagnetic energy in the low and submillimeter region. A Doppler frequency shift device used a megavolt tightly bunched beam as a moving reflecting surface from which 3 kmc power was reflected. The theoretical magnification in frequency was 27.6 times. In order to enhance the reflectivity of the electron bunches a longitudinal magnetic field was used such that the cyclotron frequency was equal to the frequency of the electromagnetic fields in the moving frame of reference. Cherenkov radiation was produced in a prebunched beam in a plasma column waveguide. The prohibitively high plasma density necessary for operation below one millimeter precluded the use of this device in the submillimeter region. Coherent inner-bremsstrahlung radiation was produced in the millimeter region at power levels in excess of a hundred milliwatts by the use of a tightly bunched relativistic electron beam. A prebunched beam was completely stopped on the flat surface of a conducting plate or a dielectric material whose permittivity was chosen such that the velocity of light in the medium was close to the beam velocity. If the physical dimensions of the device were made much larger than a wavelength then it was found that the radiation resistance was a constant independent of frequency. Furthermore, the inner-bremsstrahlung scheme used was free of physical size limitations, mode interference problems and attenuation difficulties which limited the utility of other schemes in the low and submillimeter region. Thus the only frequency limitation is the size of the bunches of the beam. Therefore, it appeared that the inner-bremsstrahlung radiation scheme is ideally suited for the generation of coherent electromagnetic power in wavelengths below one millimeter. (auth)

13685 (ASD-TN-61-86) ON THE UNATTENUATED THERMAL RADIATION FROM NEAR SEA LEVEL NUCLEAR EXPLOSIONS. J. E. Kester (Dayton, Ohio. Univ. Research Inst.). June 30, 1961. Contract AF33(616)-7017. 14p. (AD-262644)

The unattenuated thermal radiation that comes directly from the fireball onto a receiver oriented perpendicular to the radius vector out to this point is discussed. Primary emphasis is placed on the derivation of an equation for bursts intermediate to air and ground bursts, which reduces to the correct values at these two extremes. Presented also is a table of theoretical ground burst gamma values, which are used for computing the energy reflected off the terrain. (auth)

13686 (ASD-TR-61-282) REFLECTED ENERGY FROM A POINT SOURCE TO A PLANE RECEIVER, BOTH

SOURCE AND RECEIVER LOCATED BETWEEN TWO LAMBERT PLANES. Robert A. Schmall (Dayton, Ohio. Univ. Rrsearch Inst.). June 1961. Contract AF33(616)-7017. 55p. (AD-262645)

The thermal energy transferred from a point source to a plane receiver is considered. Both the source and the receiver are assumed to be located between two parallel Lambert planes, with the receiver parallel to the reflecting planes. The volume between the reflecting plane is considered to be a vacuum, that is, no attenuation of the radiant energy is taken into account. Data are presented for a source location midway between the two reflecting planes. The application and limitation of this analysis to nuclear weapons effects are discussed. (auth)

13687 (CEA-2070) STARK BROADENING OF HYDROGEN. I. Fidone (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses and European Atomic Energy Community). 1961. 10p.

The effect of electron impacts on the Stark broadening of H atoms is considered, using a Debye-Huckel potential instead of a cut-off limit for the integrals that give the shift and half-width. A slight difference is observed, typically on the order of 12 to 15%, between the Debye-Huckel and cut-off results. The simple adiabatic impact approximation is used. (tr-auth)

13688 (CNLM-1802-13) THE USE OF ULTRASONIC IN ELECTRODEPOSITION AND ELECTROPLATING. A Bibliography. Elizabeth A. Cernak, comp. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Feb. 18, 1960. Contract [AT(11-1)-229]. 3p.

A bibliography is presented containing 20 references on the use of ultrasonics in electrodeposition and electroplating. The bibliography is limited to the period from 1955 to 1959. (J.R.D.)

13689 (CU(PNPL)-211) PROGRESS REPORT [ON NUCLEAR PHYSICS] FOR JANUARY, FEBRUARY, MARCH 1961 TO THE UNITED STATES ATOMIC ENERGY COMMISSION. (Columbia Univ., New York. Pegram Nuclear Physics Lab.). Contract AT(30-1)-GEN-72. 55p.

Cross section measurements are reported on the n-p interaction at 0.5 Mev, neutron elastic scattering by O, and the neutron total cross section of Pu^{239}. An apparatus for measuring energy-dependent β-γ correlations is described. Development is reviewed on low-noise preamplifiers, a thyratron firing control system for a neutron velocity spectrometer, a sensitive limiter for use in fast coincidence systems, a current regulator for an earth's-field-compensating coil, a current regulator for a cyclotron bending magnet, and neutron velocity spectrometer improvements. (T.F.H.)

13690 (CU\PNPL)-212) PROGRESS REPORT [ON NUCLEAR RESEARCH], APRIL, MAY, JUNE 1961 TO THE UNITED STATES ATOMIC ENERGY COMMISSION. (Columbia Univ., New York. Pegram Nuclear Physics Labs.). Contract AT-30-1-GEN-72. 49p.

Measurements are reported of the cross sections for resonance and ternary fission of U^{235}, of angular distributions in the n-p interaction at 16 to 23 Mev, of mass distributions in thermal and epithermal neutron fission of U^{233}, U^{235}, and Pu^{239}, of the $B^{11}(p,\gamma)C^{12}$ giant resonance, and of the Mossbauer effect in Er^{166}. Development of circuitry is described, including transistorized sensitive discriminators and limiters, thyratron firing control systems for neutron velocity spectrometers, and a time mark generator for use with a Van de Graaff chopped beam. The development of a neutron velocity spectrometer is outlined. (T.F.H.)

13691 (DMIC-Memo-148) THE EMITTANCE OF CERAMICS AND GRAPHITES. W. D. Wood, H. W. Deem, and C. F. Lucks (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). [1962]. Contract AF 33(616)-7747. 108p.

A compilation of data on emittance, reflectance, and transmission of ceramics and graphites is presented. The data were taken from the literature published from 1940 to 1959 inclusive and from available 1960 literature. (J.R.D.)

13692 (HE-150-182) AN EXPERIMENTAL INVESTIGATION OF FREE MOLECULE MOMENTUM TRANSFER BETWEEN GASES AND METALLIC SURFACES (thesis). Robert Erwin Stickney (California. Univ., Berkeley. Inst. of Engineering Research). Jan. 25, 1962. Contract Nonr-222(45). 150p.

Measurements of the normal momentum transfer between gases and metallic surfaces were obtained under conditions of free molecule flow by means of a torsion balance and molecular beam apparatus. He, H, Ne, N, Ar, and CO_2 were investigated on W, Pt-blackened-W, Pt, and Al surfaces which were most likely contaminated with oxides and adsorbed gases. In the majority of the tests a thermal beam of gas molecules was directed against a heated test surface at normal incidence; a small number of tests were performed at oblique angles of incidence. Momentum transfer measurements were obtained with the surface at 25 to 550°C. Results indicate that the efficiency of the momentum transfer process increases with the molecular weight of the test gas and the roughness of the test surface, but is relatively independent of the surface material under the present conditions. The momentum transfer rates for He and H are significantly less than those measured for the heavier gases at the same surface temperature. The accommodation of the test gases to the surface temperature appears to be incomplete except, possibly, for Ar and CO_2. The results obtained for each gas-surface combination are used to estimate the values of two different accommodation coefficients, the coefficient of translational energy transfer and a modified form of the coefficient of normal momentum transfer. (auth)

13693 (JINR-P-864) OPREDELENIEEFFEKTIVNOSTI NABLYUDENII I CHISLA SOBYTII. (Determination of the Observation Efficiency and the Number of Events). K. D. Tolstov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1962. 9p.

The conditions are considered of the control for the efficiency of searching for the events in emulsions and on the chamber photographs. The rules are given for estimating the number of events, the efficiency and the errors in its value. (auth)

13694 (ML-877) GENERAL STUDIES IN HIGH-POWER MICROWAVE CONCEPTS. Scientific Report No. 35, July 1-September 30, 1961. (Stanford Univ., Calif. Microwave Lab.). Nov. 1961. Contract AF19(604)-1930. 42p. (AFCRL-1124)

Progress in basic investigations concerned with generation and transmission of radiation in the spectral microwave region is reported. Development work is described on electrostatic-beam parametric amplifiers for low-noise applications, electron beam interactions with plasma, production of thermal plasmas, nonlinear plasma theory, microwave noise in plasma, electron beam interactions with Co, plasma, and plasma harmonic generation. (J.R.D.)

13695 (MND-P-2720) STRONTIUM-90 FUELED THERMOELECTRIC GENERATOR POWER SOURCE FOR FIVE-WATT U. S. COAST GUARD LIGHT BUOY. Final Report. (Martin Co. Nuclear Div., Baltimore). Feb. 2, 1962. Contract AT(30-3)-217. 140p.

The objectives of the SNAP 7A program were to design, manufacture, test, and deliver a five-watt electric generation system for a U. S. Coast Guard 8 × 26E light buoy. The 10-watt Sr^{90} thermoelectric generator, the d-c-to-d-c converter, batteries and the method of installation in the light buoy are described. The SNAP 7A generator was fueled with four capsules containing a total of 40,800 curies of Sr^{90} titanate. After fueling and testing, the SNAP 7A electric generating system was installed in the Coast Guard light buoy at Baltimore, Maryland, on December 15, 1961. Operation of the buoy lamp is continuous. (auth)

13696 (NAA-SR-Memo-6670) PERFORMANCE TESTS OF SNAP 10A THERMOELECTRIC ELEMENTS. C. G. Bergdorf (Atomics International. Div. of North American Aviation Inc., Canoga Park, Calif.). Aug. 30, 1961. Contract [AT(11-1)-Gen-8]. 18p.

Apparatus for the performance testing of SNAP 10A thermoelectric elements was designed, constructed, and is now in operation. Elements may be tested for any desired length of time up to 1400°F and in a vacuum of 1×10^{-5} mm of Hg. The equipment used for these tests may also be utilized for measuring Seebeck coefficient and resistance as a function of temperature. Element performance is derived from the data on voltages and temperatures. The performance variables which are reported in graphic form are as follows: loaded output voltage at any desired ΔT; open circuit output voltage at any desired ΔT; power output under optimum load conditions; current produced under matched load conditions; and internal resistance of the element. (auth)

13697 (NP-11338) X-RAY DIFFRACTION STUDIES OF THERMAL MOTIONS IN CRYSTALS. Annual Report No. 3, June 1, 1960 to May 31, 1961. R. A. Young and R. M. Nicklow (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contracts NOnr 991(00) and 991(06). 69p.

Research has been continued on the general study, primarily by x-ray intensity–temperature (I vs T) measurements, of thermal motions in crystals and their interaction with other phenomena of interest in crystal physics. Critical re-examination of experimental techniques has led to a better understanding of background intensities and subsequently to the solution of several persistent problems including: difficulties with balancing filters; abnormally high relative intensities of the (111) and (333) reflections of AgCl; the "anomalous" behavior of the (111) intensity of AgCl as a function of temperature and of wavelength; and the peaking, large size, and angular dependence of the under-peak background observed with balanced filters. A graphical method has been developed for comparing the temperature dependence of the normalized temperature slope of log I vs T, A(T), with the theoretical prediction, f(x), by means of log-log plots. Results indicate that the method is very sensitive to discrepancies between experimental observations and theory, and that the Debye-Waller theory does not adequately describe the temperature dependence of Bragg intensities for AgCl. Further analytic investigation of the dependence of A on $(\sin^2\theta/\lambda^2)$ for an NaCl type crystal, including a certain simple thermal diffuse scattering contribution, has resulted in a graphical method which can be used to separate the contributions of the individual atom types to the slope of log I vs T. Thermal expansion data for AgCl, NaCl, and Al in the 100 to 300°K range were obtained. The AgCl data were used to determine the Debye through comparison of the experimental results with the Mie-Grüneisen theory. The discrepancies found between theory and experiment indicate a breakdown in the simplified Mie-Grüneisen thermal expansion theory used, or the Debye lattice vibration theory, or both, for AgCl. (auth)

13698 (NP-11363) SEARCH FOR DIRAC MAGNETIC POLES. E. Amaldi, G. Baroni, A. Manfredini (Rome. Università. Istituto di Fisica), H. Bradner (California. Univ., Berkeley. Lawrence Radiation Lab.), L. Hoffmann, G. Vanderhaege (European Council for Nuclear Research, Geneva), and H. G. de Carvalho (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). Sept. 20, 1961. 15p. (Notas de Fisica, Vol. VIII, No. 15(p.251-64)).

Experiments are described in which graphite targets were placed in the 27.2-Bev circulating beam of the CERN Proton Synchrotron to determine the upper limit for production of pole pairs in proton-nucleon collisions. Exposures of Al, Cu–Cr, and Al–polyethylene targets were also made. All tracks in the experimental emulsions were scanned however none could be found which could be attributed to magnetic poles. (J.R.D.)

13699 (NP-11426) THE ELASTIC SCATTERING OF 11.5-17.7 MEV PHOTONS BY Au MEASURED WITH A BREMSSTRAHLUNG MONOCHROMATOR. Technical Report No. 31. (Revision of Technical Report 21). J. S. O'Connell, P. Tipler, and P. Axel (Illinois. Univ., Urbana. Physics Research Lab.). Jan. 1962. Contract ONR 1834 (05). 124p.

An electron-bremsstrahlung photon monochromator with an energy resolution of 0.67% is described. Monochromatic photon beams from this unit are used to study the elastic scattering cross sections of photons on Au at 11.5 to 17.7 Mev. (T.F.H.)

13700 (NP-11429) MODIFICATION OF THE RYDBERG–KLEIN–REES METHOD FOR OBTAINING POTENTIAL CURVES FOR DOUBLET STATES INTERMEDIATE BETWEEN HUND'S CASES (a) AND (b). Technical Report No. 5. Joseph T. Vanderslice (Maryland. Univ., College Park. Inst. of Molecular Physics). Feb. 25, 1962. Contract Nonr 595(14). 20p.

The Rydberg–Klein–Rees method for obtaining potential energy curves from band-spectroscopic data is modified in order to handle certain doublet electronic states. The spin-axis coupling constant is taken to be independent of distance. The modified equations are used to calculate the curves for the $X^2\Pi$ state of NO. (auth)

13701 (NP-11588) APPARATUS FOR THE INVESTIGATION OF THE MÖSSBAUER SPECTRA AT ROOM TEMPERATURE. J. Bara, A. Z. Hrynkiewicz, D. S. Kulgawczuk, and H. Lizurej (Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow). Dec. 1961. 10p. (PAN-154)

The apparatus described can be used for the study of the resonance absorption of γ rays at room temperature for negative and positive velocities of relative source-absorber motion. The uniform motion is achieved by a rotating cam of very simple design. (auth)

13702 (NYO-9602) KINETIC MODELING OF GAS MIXTURES. Lawrence Sirovich (New York Univ., New York. Courant Inst. of Mathematical Sciences). Feb. 1, 1962. Contract AT(30-1)1480. 39p. (MF-27)

Kinetic models for multi-component gases are given. It is shown that some of the most important features of the Boltzmann equation are retained in spite of the simplicity of the model equations. An iteration procedure on the model equation is carried out and is identified with the Chapman-Enskog procedure. Linear and non-linear formal procedures for developing the models and their extensions are also given. (auth)

13703 (PAN-273/I-B) THE OXYGEN PARAMETER IN PbO_2 DETERMINED BY NEUTRON DIFFRACTION. Janusz Leciejewicz and Izabela Padlo (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Sept. 1961. 7p.

The crystal structure of PbO_2 was confirmed to be of rutile type. No evidence was found for a superstructure. The O parameter was determined to be $x = 0.309 \pm 0.004$. The discussion of probable errors is given. (auth)

13704 (TID-13446) ANNUAL RESEARCH REPORT NO. 3. (Massachusetts Inst. of Tech., Cambridge. Lab. of Chemical and Solid-State Physics). July 15, 1961. Contract AT(30-1)-858, et al. 61p.

Progress is reported on research in solid-state and molecular theory, structure of solids by x-ray and neutron diffraction, low-temperature and thermal properties of matter, nuclear magnetism, molecular spectroscopy, interatomic and intermolecular forces, transition metal compounds, electrical and optical properties of thin metal deposits, physical chemistry of macromolecules, physical metallurgy, and mechanical properties of solids. (M.C.G.)

13705 (TID-14943) TECHNICAL PROGRESS REPORT ON PHOTOVOLTAIC EFFECTS OCCURRING WITH ANODIZED ZIRCONIUM AND NIOBIUM ELECTRODES. (Temple Univ., Philadelphia). Feb. 1962. Contract AT(30-1)-2775. 20p.

Activities are described in an investigation of the photovoltaic effects which occur with anodized Zr and Nb electrodes. Photovoltaic decay curves were obtained, and a proposed theory to explain the curve configurations is presented. It is noted that the tentative conclusions reached at this point in the program may have important ramifications to the corrosion of these metals in ultraviolet light. (J.R.D.)

13706 (TID-15198) SOME ELEMENTARY ASPECTS OF WAVE PROPAGATION IN VISCOELASTIC BAR. Technical Report No. 16, Y. C. Das and C. C. Hsiao (Minnesota. Univ., Minneapolis. Inst. of Tech.). July 1961. Contract AT(11-1)-532. 24p.

An investigation of the plane wave propagation was carried out with general boundary conditions. The nature of strain wave propagation due to an impact was taken into consideration. Other factors were considered and the analysis was effected by reducing the time dependent boundary conditions to those independent of time. Discussions are also included on equation of motion of longitudional vibration in a bar, stress-strain relations of Maxwell and Voigt media, plane wave and strain wave propagation in a semi-finite rod of Maxwell medium, and wave propagation in viscoelastic bar of Voigt medium. (J.R.D.)

13707 (WADD-TR-60-22(Pt.I)) THERMOPILE GENERATOR FEASIBILITY STUDY. PART I. SUMMARY. Final Report. R. L. Gessner, ed. (General Electric Co., Schenectady, N. Y.). Aug. 1960. Contract AF33(616)-5281. 108p. (AD-268590)

A summary is given of the research and development study of the use of thermopile generators as power sources in future air and space weapon systems. Materials development, performance studies, and generator design are described. (D.L.C.)

13708 (WADD-TR-60-22(Pt.II)) THERMOPILE GENERATOR FEASIBILITY STUDY. PART II. MATERIALS INVESTIGATIONS. Final Report. J. H. Bredt, ed. (General Electric Co., Schenectady, N. Y.). Aug. 1960. Contract AF33(616)-5281. 338p. (AD-265599)

Details are given for the materials development studies conducted as part of the research and development study of the use of thermopile generators as power sources in future air and space weapon systems. (D.L.C.)

13709 (WADD-TR-60-22(Pt.IV)) THERMOPILE GENERATOR FEASIBILITY STUDY. PART IV. GENERATOR DESIGN. Final Report. R. L. Gessner, ed. (General Electric Co., Schenectady, N. Y.). Aug. 1960. Contract AF33(616)-5281. 93p. (AD-268591)

Detailed descriptions are given on junction fabrication and test and on thermoelectric generator design. A 5-watt generator model is described. Specifications are given for a 100-watt solar thermoelectric generator. (D.L.C.)

13710 (WT-716) FREE-FIELD MEASUREMENTS OF EARTH STRESS, STRAIN, AND GROUND MOTION. W. R. Perret and V. L. Gentry (Sandia Corp., Albuquerque, N. Mex.). Feb. 1955. Project 1.4 [of] Operation UPSHOT-KNOTHOLE. 102p.

Free-field phenomena in the ground resulting from atmospheric atomic explosions 1, 9, and 10 of Operation Upshot-Knothole are studied. The attenuation of earth stress with depth is determined and the data are fit to empirical curves. Arrays of directionally sensitive ground stress and strain gauges and accelerometers are installed at a depth of 5 ft, in order to test the feasibility of the use of these instruments and to determine the stress and strain tensors associated with the air bursts. (T.F.H.)

13711 (FTD-TT-61-276) NEWS OF THE INSTITUTES OF HIGH LEARNING, PHYSICS (SELECTED ARTICLES). Translation of Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 1, 20-3; 138-42(1961). 18p.

Two articles are presented. One of the articles has been separately abstracted. The remaining article deals with the mechanisms of electrical erosion during a high-voltage spark discharge in a gas. (T.F.H.)

13712 (FTD-TT-61-276(p.1-8)) THE CALCULATION OF ACCELERATED-PARTICLE LOSS DUE TO SCATTERING GAS. A. G. Vlasov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 1, 20-3(1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 28631.

13713 (JPRS-12754) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS, MINISTRY OF HIGHER AND SECONDARY SPECIALIZED EDUCATION, RADIO PHYSICS SERIES. Translation of Izvestiya Vysshykh Uchebnykh Zavedenii, Radiofizika, 4: No. 3, 389-584(1961). 408p.

Twenty three papers are presented. Four of the papers have been abstracted separately. The remaining papers discuss the following subjects: lunar, solar, and Venusian radiowave emission; radioastronomy techniques in the centimeter band; radiowave propagation over rough surfaces; quantum amplifiers; effective temperatures of stationary nonequilibrium systems; noise in excited two-level media; sensitivity of radio receivers; analysis of nonstationary fluctuation spectra; effects of inhomogeneities on slow-wave systems; relativistic dispersion equations for waveguide systems having helical and trochoidal electron beams; gas-discharge microwave mixers; a simple extremal regulator with a self-oscillating search; induction emf spectra in the cyclic reversal of ferromagnetism; impact damper theory; and the analysis of linear automatic systems by means of digital computers. (T.F.H.)

13714 (JPRS-12754(p.118-38)) ON THE INSTABILITY OF LOW FREQUENCY ELECTROMAGNETIC WAVES IN PLASMA WITH A BEAM OF CHARGED PARTICLES (THE PROPAGATION AT AN ARBITRARY ANGLE TO THE DI-

RECTION OF THE MAGNETIC FIELD). M. S. Kovner. Translated from Izvest. Vysshykh Ucheb. Zavedenii, Radiofiz., 4: 444-54(1961).

The stability of a system relative to low-frequency waves is examined on the basis of the kinetic equation method. The general dispersive relation is given and criteria are found for increase and attenuation of the waves for the following limiting cases: that in which the effects of thermal motion on the propagation of the wave and the stability of the system are negligible; and that in which thermal velocities are large. (auth)

13715 (JPRS-12754(p.139-59)) ELECTROMAGNETIC WAVE PROPAGATION IN AN UNSTABLE MAGNETOACTIVE PLASMA. M. I. Petelin. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 4: 455-64(1961).

An examination is made of the instability conditions relative to a perturbation in the form of a plane electromagnetic wave propagated at an arbitrary angle to the constant magnetic field, for a uniform magnetoactive plasma that has nondispersive electron momentum distributions in both the longitudinal and transverse directions. (auth)

13716 (JPRS-12754(p.160-80)) PARAMETER FLUCTUATIONS OF AN ELECTROMAGNETIC FIELD PROPAGATED THROUGH A MAGNETO-ACTIVE PLASMA WITH RANDOM FLUCTUATIONS OF ELECTRON DENSITY AND MAGNETIC FIELD. F. G. Bass. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 4: 465-75(1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 32860.

13717 (JPRS-12754(p.379-86)) TRANSITION RADIATION IN MOVING MEDIA. K. A. Barsukov and L. G. Naryshkina. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 4: 574-7(1961).

A study is made of the transition radiation emitted by a charged particle as it crosses the interface between a vacuum and a rapidly moving plasma. The particle and plasma motions are assumed parallel. The result is shown to be similar to that for a stationary plasma, with a modified value for the plasma frequency. (T.F.H.)

13718 (NP-tr-869) THE DISCRETE STRUCTURE OF CHARGE IN A DOUBLE LAYER. B. V. Ershler. Translated by R. W. Hummel (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Zhur. Fiz. Khim., 20: 679-92(1946). 31p.

An investigation is described in which allowances are made for the discrete nature of charges in a double layer for the case when both phases remain electrically neutral while a double ionic layer emerges on the common boundary. Such a layer is obtained, for example, on Hg at a potential maximum as the result of anion adsorption. An ionic model for the phenomenon is proposed. (J.R.D.)

13719 THE INFLUENCE OF RADIATION ON THE CHEMISTRY OF DEFECTS IN KCl–Ag. R. I. Gindina and Ch. B. Lushchik. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 15, 81-102(1961). (In Russian)

Irradiation with x ray and ultraviolet light and subsequent bleaching form new luminescence centers in KCl-Ag crystals. An investigation of the centers and of the activator color centers lead to the conclusion that the new centers are silver ions associated with negative ion vacancy. The mechanism of producing centers by irradiation is discussed. (auth)

13720 ON THE LUMINESCENCE MECHANISM OF ALKALI HALIDE CRYSTALS EXCITED BY ULTRAVIOLET OR IONIZING RADIATIONS. Ch. B. Lushchik, G. G. Liidya (Liidja), T. A. Soovik, and I. V. Yaek (Jaek). Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 15, 103-26 (1961). (In Russian)

A complex experimental investigation was made of physical processes in alkali halide single crystals activated by mercury-like ions (Ga^+, Ge^{2+}, In^+, Sn^{2+}, Tl^+, Pb^{2+}). The elementary excitations of ionic crystals and their mutual transformations and interactions with defects of crystal lattice are considered. Special attention is focused of the differences between luminescent characteristics of activated alkali iodides in the cases of generation of three types of elementary excitations: excited states of centers, excitons, and electron-hole pairs. The luminescent characteristics in the case of creation of a number of elementary excitations by γ and x rays are compared with luminescent characteristics, while only one elementary excitation sort is created by monochromatic ultraviolet radiation. The contribution of both excitons and electron-hole pairs to the scintillation process in ionic crystals is discussed. (auth)

13721 NONISOTHERMAL RELAXATION PROCESSES IN KBr–Tl SINGLE CRYSTALS, EXCITED BY X-RAYS OR ULTRAVIOLET RADIATION. I. V. Yaek (Jaek) and T. I. Eksina. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 15, 127-37(1961). (In Russian)

Nonisothermal relaxation processes in deformed and undeformed KBr-Tl single crystals were compared in the cases of x ray and ultraviolet excitation (from the region of activator and exciton absorption bands). Some specific peculiarities in the course of relaxation process, which are dependent upon the type of excitation, were revealed in the deformed crystals. It was concluded that the processes lead to the electron-hole mechanism of excitation of recombination luminescence in the case of x irradiation. (auth)

13722 QUANTUM THEORY OF MEASUREMENT. Richard A. Mould (New York State Univ., Oyster Bay). Ann. Phys. (N. Y.), 17: 404-17(Mar. 1962).

When a quantum mechanical measurement is made, the initial wave that otherwise evolves continuously under a time-dependent Schrödinger process collapses discontinuously to the measured state. This process was formalized by defining the general transformation whereby a pure state is converted discontinuously into a statistical mixture in a measurement interaction. It was concluded that the continuous Schrödinger process and the mixture conversion process are both fundamental theoretical necessities, and that they together represent a nonclassical relationship between observer and the observed. It is shown that the classical observer-observed relationship can be made consistent with quantum mechanical measurement, and that when this is done the Schrödinger theory is sufficient to account for measurement processes without "essential" discontinuity. This requires that the notion of boundary conditions be extended to include four-volume qualifications of a kind not necessary in classical physics, and that the task of the theory be given a special formulation. The scheme is shown to make a sound and natural connection with mixture theory for the purpose of handling inaccurate and (or) incomplete boundary observations. Assumptions of the scheme are compared with the classical and current assumptions, and comments bearing on further theoretical study are added. (auth)

13723 ELECTROMAGNETIC PLANE WAVE SOLUTIONS IN GENERAL RELATIVITY. Kenneth Nordtvedt and Heinz Pagels (Stanford Univ., Calif.). Ann. Phys. (N. Y.), 17: 426-35(Mar. 1962).

The problem of Rainich for null fields is examined, and it is found that for particular geometries the electromagnetic field is not unique. In the case in which the propagation and polarization vectors are harmonic, the geometry admits an electromagnetic potential that excludes the existence of magnetic monopoles. An explicit solution for a null electromagnetic plane wave of arbitrary pulse shape is obtained. It is found that no gravitational field external to the pulse is generated. (auth)

13724 ENERGY TRANSFER BETWEEN A MOVING BODY AND A MAGNETIC FIELD. P. R. Smy (Univ. of British Columbia, Vancouver). Can. J. Phys., 40: 301-16 (Mar. 1962).

The inductive transfer of energy between a moving body and a magnetic field is discussed together with its significance in the fields of direct energy conversion and plasma propulsion. The investigation is centered upon the interaction between a moving body and a sinusoidally oscillating magnetic field of idealized distribution. Scaling laws governing the physical variables of the interaction are derived, and the values of the resultant parameters necessary to obtain maximum energy transfer are calculated. It is found that under these conditions, the initial kinetic energy of the body can be increased by ~14 times or decreased to ~$^1/_{14}$ during the interaction. The relation between these parameters (and hence the energy transfer) and the all important energy transfer/recirculating energy ratio is obtained, and it is shown that a working energy factor ~6 (or $^1/_6$) is a more feasible proposition. (auth)

13725 THE MECHANISM OF PENETRATION OF STRANGE ATOMS INTO A CRYSTALLINE LATTICE. CASE OF THE ACTIVATION OF ZINC SULFIDE OR CADMIUM SULFIDE LUMINOPHORS. Marguerite Bancie-Grillot, Andréa Levialdi, and Edmond Grillot (Universidad, Buenos Aires and Université, Paris). Compt. rend., 253: 2914-16(Dec. 18, 1961). (In French)

The previous results of one of the authors (Compt. rend., 238: 1216(1954)) has led to the proposal of two hypotheses to explain the role of "mineralizing agents" in the incorporation of strange cations in crystals such as those of zinc sulfide. They cause a micromodification of structure either by preliminary fixation of strange anions or under the effect of surface energy states. These processes can be complementary. (tr-auth)

13726 THE NUCLEAR RELAXATION OF IRON-57 IN THE GARNET OF IRON AND YTTRIUM. Pierre-Gilles de Gennes and Françoise Hartmann-Boutron. Compt. rend., 253: 2922-4(Dec. 18, 1961). (In French)

The effect of rare earth impurities, with fast electron relaxation, on the nuclear relaxation frequency $1/T_1$ of Fe^{57} was studied at low temperatures. It is foreseen that, as in all ray lengths in ferromagnetic resonance, $1/T_1$ will pass through a maximum in the temperature region where the relaxation frequency and the frequency of impurity precession are equal. (tr-auth)

13727 EXPERIMENTAL STUDY OF THE NUCLEAR RELAXATION OF IRON-57 IN YTTRIUM GARNET. Claude Robert and Jacques-Michel Winter (Centre d'Études Nucléaires, Saclay, France). Compt. rend., 253: 2925-7 (Dec. 18, 1961). (In French)

The relaxation times of Fe^{57} nuclei in the local field of d sites of yttrium and iron garnet were studied as a function of the magnetic field and of the temperature. Two mechanisms will permit an explanation of the experimental results: the movement of rare earth impurities and the scattering of spin waves by the nuclei of Fe^{57}. (tr-auth)

13728 MEASUREMENT OF THE TOTAL ELECTRICAL CURRENT FURNISHED BY A NUCLEAR EXPLOSION. Jean Ferrieu and Yves Rocard. Compt. rend., 253: 2931-2 (Dec. 18, 1961). (In French)

An electrical blanket, a lattice of conducting wires extended under a nuclear explosion, captures practically all the electrical current drawn to the earth by this explosion. A crest of such a current was measured which reached 150,000 amps during the fourth French nuclear explosion in the Sahara. The current extended a slight distance above the soil. (tr-auth)

13729 VARIATION OF THE IONIZATION IN THE VICINITY OF THE INTERFACE BETWEEN TWO MEDIA EXPOSED TO γ RAYS OF Co^{60}. Jean Dutreix, Andrée Dutreix, and Michel Bernard (Institut G. Roussy, Villejiif, France and Centre d'Arsonval, Limoges, France). Compt. rend., 153: 2936-7(Dec. 18, 1961). (In French)

The dose absorbed in regions where the electron equilibrium is not realized was determined. The measurements were made under the following conditions: (1) the walls of the ionization chamber were all of the same material; (2) the anterior wall is of graphite and the posterior wall of a metal M, with the separation ring being constructed half of metal and half of graphite; (3) the anterior wall is of the metal M and the posterior wall of graphite with separation ring as in the preceding case. The relative ionization in the chamber with homogeneous walls, in the chamber with carbon–M, and in the chamber with M–carbon was measured. The measurements permitted a determination of the effective dose delivered in radiotherapy and in radiobiological studies on cells in the vicinity of a material with high Z. (J.S.R.)

13730 TIME CHANGES IN VELOCITY AND LENGTH OF STRIATIONS IN WAVE OF STRATIFICATION IN HYDROGEN DISCHARGE. L. Pekárek and V. Krpata (Inst. of Physics, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B 11: 849-51(1961). (In English)

Data were obtained from oscillograms of light intensity changes at different distances from the discharge cathode (L. Pekárek, Czech. J. Phys., 9: 67(1959)). Striation velocities decreased with time, as did oscillation frequencies in the oscillation packet, corresponding to the striation motion before the photomultiplier slit. (L.N.N.)

13731 THE CHANGE IN THE PARAMETERS OF STRIATIONS IN A WAVE OF STRATIFICATION. M. Novák (Inst. of Physics, Czechoslovak Academy of Sciences, Prague) and T. Růžička. Czechoslov. J. Phys., B 11: 878-80(1961). (In English)

A wave of stratification produced after an aperiodic perturbation of a positive column plasma in a Ne d-c discharge at about 1 amp was measured, and parameter changes were found. The wave of stratification was measured above the upper limit of self excitation (905 ma); the current was 910 ma. Oscillographic records and striation velocity time dependence data are presented in graphical form. (L.N.N.)

13732 ON INFRA-RED DIVERGENCE IN QUANTUM ELECTRODYNAMICS. P. Smrž (Inst. of Physics, Czechoslovak Academy of Sciences, Prague) and I. Úlehla. Czechoslov. J. Phys., B 12: 1-11(1962). (In English)

Cancellation of infrared divergence in the perturbation theory of quantum electrodynamics is discussed. The prescription for the cancellation of the infrared divergence in the interaction energy of an electron and electromagnetic field is given to all orders of perturbation theory. It is shown that the magnetic moment of electron computed

to an arbitrary order of perturbation theory is not dependent on the mode of regularization of divergent integrals in the infrared region. (auth)

13733 THE X-RAY LUMINESCENCE OF NaCl CRYSTALS WITH COBALT. J. Dolejši, M. Lébl, and J. Trnka (Inst. of Solid State Physics, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B 12: 77-8 (1962). (In German)

Results of studies on induced luminescence of NaCl using x-emitting Co are presented. Methods of growing the crystals and determining the impurity content are analogous to those for Cu (J. Trnka, Cs. Cas. Fys 7: 187(1957). Photometric emission spectral data at 320 and 440°K are presented in graphical form. (L.N.N.)

13734 X-RAY LUMINESCENCE OF AgCl CRYSTALS. Z. Berger and E. Vavřinec (Charles Univ., Prague). Czechoslov. J. Phys., B 12: 79(1962). (In English)

Spectral composition of x-ray induced luminescence in AgCl crystals was studied. The qualitative course of radiation intensity was plotted as a function of wave length. The curve was obtained by photometric measurements on crystals from different growth groups. The curves coincide in shape and position of the main and lateral positions. Luminescence intensities of AgCl crystals with admixtures of Cd were also analyzed; intensities decreased with increasing numbers of admixtures. (L.N.N.)

13735 SHOCK-TUBE EXPERIMENTS INVOLVING PHASE CHANGES. E. Terner (Armour Research Foundation, Chicago). Ind. Eng. Chem., Process Design Develop., 1: 84-6(Apr. 1962).

A shock tube, vertically mounted, contains a liquid in the lower driver section; the upper driven section is either filled with gas at some selected pressure or is vented to atmosphere. The liquid is heated under pressure such that boiling is prevented; it is then suddenly decompressed by the bursting of a diaphragm separating the driver from the driven section. As the diaphragm breaks, a decompression pulse is propagated downward through the fluid; at the same time, the heated liquid will start to vaporize at the interface and will eventually discharge vapor into the driven section. Pressure-time recordings are taken at different stations, along the tube; the results obtained within the driver section allow a comparison of the propagation and attenuation of the decompression pulse in cold water and preheated water. From pressure records taken at the driven section, vaporization proceeds at a rather slow rate, and independently of the wave motion ensuing diaphragm rupture. (auth)

13736 A HIGH CURRENT RADIO FREQUENCY PROTON SOURCE WITH RADIAL EXTRACTION. Mohamed E. Abdelaziz (Argonne National Lab., Ill.). IRE Trans. on Nuclear Sci. NS-9, No. 2, 1-10(Apr. 1962).

A theory outlining the mechanism of the low pressure hydrogen plasma used in radiofrequency proton sources is given. Taking into account secondary emission from surfaces of plasma vessel, it is shown that the electron density is maximum at the tube's center. This is confirmed experimentally, and a source is designed with its extraction electrode positioned radially near the plasma center. Compared with axial extraction used in conventional r-f sources, radial extraction yields beam currents over 20% higher, and allows the application of higher extraction voltages. Beam currents up to 150 ma can be extracted, of which more than 85% is proton current. Two methods are used for the measurement of the emittance of the accelerated beam. (auth)

13737 ELECTRON LEVELS IN STRONG EXTERNAL FIELDS. V. V. Voronkov (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedenií, Fiz., No. 5, 152-7(1961). (In Russian)

An interpretation is given of a Dirac equation spectrum in an external field, and its properties are investigated near Z_{cr} for the cut-off Coulomb field and U_{cr} for the potential well. (tr-auth)

13738 AN APPROXIMATE ANALYSIS OF LAMINAR MAGNETOHYDRODYNAMIC FLOW IN THE ENTRANCE REGION OF A FLAT DUCT. M. Roidt (Westinghouse Research Labs., Pittsburgh) and R. D. Cess. J. Appl. Mechanics, 29: 171-6(Mar. 1962).

Laminar flow of a conducting fluid with constant properties entering a semi-infinite flat duct with a transverse applied magnetic field is considered. The fluid is assumed to enter the duct with a uniform velocity profile. The duct walls are nonconducting and a variable external resistance connects the two end plates which are displaced to infinity. The velocity and pressure distributions are then determined for the region between the inlet and fully developed flow. A method is used wherein the flow field is divided into two sections and an appropriate analysis utilized in each. In the section near the inlet a boundary-layer formulation of equations is used and a solution developed in a series stream function with Blasius functions as coefficients. When this solution becomes unwieldy, an exponential velocity deviation from the fully developed flow is assumed and joined to the boundary-layer solution to complete the description of the flow. (auth)

13739 MAGNETOHYDRODYNAMIC FLOW AND HEAT TRANSFER ABOUT A ROTATING DISK. E. M. Sparrow (Univ. of Minnesota, Minneapolis) and R. D. Cess. J. Appl. Mechanics, 29: 181-7(Mar. 1962).

The effects of an axial magnetic field on the flow and heat transfer about a rotating disk were analyzed. It was found that the presence of the magnetic field significantly decreases the flow velocities; but increases the torque required to maintain steady rotation of the disk. The heat transfer was also decreased by the magnetic field, with greater reductions occurring for low Prandtl number fluids. (auth)

13740 EXPERIMENTAL EVIDENCE OF LANDAU DAMPING IN ELECTRON BEAMS. M. Caulton, B. Hershenov, and F. Paschke (Radio Corp. of America, Princeton, N. J.). J. Appl. Phys., 33: 800-3(Mar. 1962).

Investigations were made of plasma oscillations by studying space-charge waves in velocity-modulated electron beams. The convection current in a velocity-modulated slowly-drifting electron beam was measured as a function of distance from the modulating cavity. The experiments indicated that in the presence of an appreciable velocity spread, the fast space-charge wave was damped while the slow space-charge wave remained unattenuated. The measurements were made under conditions where the velocity spread was dominated by lens effects in the electron-optical system. The results demonstrated the existence of Landau damping. (auth)

13741 IONS SPUTTERED FROM COPPER. R. C. Bradley and E. Ruedl (Cornell Univ., Ithaca, N. Y.). J. Appl. Phys., 33: 880-8(Mar. 1962).

Positive ions sputtered from copper under a variety of bombardment and surface conditions are mass analyzed and found to include species characteristic of the incident ions, of copper and some of its compounds, and of alkali metal impurities. A model is described that accounts for most of the properties of the "reflected" ions, not in terms of reflection but in terms of the amount of gas trapped and released by the surface. The ionizing agent

is unknown but is thought to be the bombarding ions (or their secondary electrons) rather than the surface. The Cu^+ ions, on the other hand, seem to be surface-ionized sputtered particles originating from patches of high local work function. Yield data seem to correlate qualitatively with probable changes in work function caused by adsorption of impurities, sputtering, or vacuum annealing. The CuO^+ peak is believed to be caused by dissociation and ionization of cuprous oxide molecules under the action of the ion bombardment. The rates of formation and disappearance of this peak are studied under various circumstances. An unusually high sputtering rate is found to occur at an argon bombarding energy of 75 ev. Na and K impurities sputtered from and ionized by the copper surface showed transient effects that can be interpreted in terms of a low sputtering probability compared to the base metal. The relevance of these experiments to sputtering theories, ion pumping, oxidation, cleanup, and surface ionization theory is discussed. (auth)

13742 THALLIUM-ACTIVATED ZnS PHOSPHORS. A. Wachtel (Westinghouse Electric Corp., Bloomfield, N. J.). J. Electrochem. Soc., 109: 306-9(Apr. 1962).

Firing of ZnS with Tl_2S + S in sealed tubes results in yellow photoluminescence peaked at 590μ as well as thermoluminescence and infrared-stimulated emission with the same color. In the presence of Cu or Ag, the photoluminescence is red and peaks at 835 mμ. This emission is excited at wavelengths where ZnS:Cu, Cl or ZnS:Ag, Cl, respectively, emit. The thermoluminescence and infrared-stimulated emission, at room temperature, of ZnS:Ag, Tl is yellow; in the case of ZnS:Cu, Tl, the stimulated emission contains yellow and red components. (auth)

13743 THE EFFECT OF Li AND Ti ON ZnS:Cu AND ZnS:Ag PHOSPHORS. A. Wachtel (Westinghouse Electric Corp., Bloomfield, N. J.). J. Electrochem. Soc., 109: 309-12(Apr. 1962).

ZnS:Cu, Li fired in H_2S or H_2 shows blue and green photoluminescence peaked at 443 and 510 mμ, respectively. Addition of Ti quenches this emission and causes red and infrared emission peaked at 730 and 830 mμ, respectively. Infrared radiation stimulates the red emission and also quenches the blue and green bands. ZnS:Ag, Li, Ti emission in the orange with a band peaked at 640 mμ and an infrared band peaked at 810 mμ. In the absence of Ti, ZnS:Ag, Li shows properties essentially similar to those of ZnS:Cu, Li, except for a weak orange-yellow infrared-stimulated emission. (auth)

13744 VIBRATIONAL CONSTANTS FOR THE GROUND STATE OF THE HYDROGEN MOLECULE. J. Baran and W. Kołos (Inst. of Physical Chemistry, Polish Academy of Science, Warsaw). J. Mol. Spectroscopy, 8: 121-5(Feb. 1962).

A potential energy curve for the ground state of H_2 was approximated by a power series, and the vibrational constants calculated. They differ by ± 1 cm^{-1} from the experimental values. (auth)

13745 1,3,5-TRIARYL-2-PYRAZOLINES AS WAVE LENGTH SHIFTERS IN SCINTILLATION PLASTICS. Stanley R. Sandler, Samuel Loshaek, Edward Broderick, and K. C. Tsou (Borden Chemical Co., Philadelphia). J. Phys. Chem., 66: 404-8(Mar. 1962).

A series of substituted 1,3,5-triaryl-2-pyrazolines was shown to be a good wave length shifter in plastic scintillators. The importance of the aryl group in position 3 is shown by the fact that 1,5-diphenyl-3-methyl-2-pyrazoline is not an effective wave length shifter. The 5-position, on the other hand, can be replaced by a methyl group without affecting its efficiency as a wave length shifter. The substituent effects and their relationship to the excited state of the 2-pyrazoline nucleus are discussed. (auth)

13746 LIFE-TIME OF POSITRONS IN ALUMINUM, COPPER, AND GOLD. N. Longequeue, R. van Zurk, and R. Bouchez (Université, Grenoble, France and Centre d'Etudes Nucléaires, Grenoble, France). J. phys. radium, 22: 61S-3S(Nov. 1961). (In French)

The annihilation of positrons in insulators and in Al, Cu, and Au was studied. Two annihilation periods were observed in the insulators, and the time distributions were in good agreement with results obtained by other authors. The lifetime of the positrons in the metals for the two annihilation periods observed was tabulated. It appears that in the metals there is either direct annihilation with the conduction electrons or formation of bound states with the core electrons and annihilation by "pick-off" of the positrons in the triplet state. (J.S.R.)

13747 RELATIVE INTENSITIES OF X RAYS OF THE L SPECTRUM, EXCITED BY ELECTRON BOMBARDMENT OF THE HEAVY ELEMENTS. Marcel Goldberg (Institut du Radium, Paris). J. phys. radium, 22: 743-8(Nov. 1961). (In French)

Relative intensities of L x rays were measured for the following elements: Ta, W, Re, Pt, Au, Hg, Tl, Pb, Bi, Th, and U. A 50 kv x-ray tube was used. To analyze the rays a bent-crystal spectrometer (Cauchois) and a NaI(Tl) scintillation counter + photomultiplier were employed. The results are corrected for crystal-reflecting power and target absorption. (auth)

13748 COLLOQUIUM ON NUCLEAR PHYSICS AT LOWER AND MEDIUM ENERGIES AT STRASBOURG, MAY 23, 24, AND 25, 1961. J. phys. radium, 22: Suppl. to No. 11, 141A-81A(Nov. 1961). (In French)

The papers presented at this colloquium are abstracted separately. (L.T.W.)

13749 REMOTE-CONTROL DISPLACEMENT OF AN ION SOURCE DURING OPERATION IN AN ELECTROSTATIC ACCELERATOR. B. Olkowsky (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, Suppl. to No. 11, 143A-4A(Nov. 1961). (In French)

An apparatus for moving an ion source by remote control, while operating in a Van de Graaff, is described. This allows the beam to be recentered more efficiently. (auth)

13750 BEAM PULSE APPARATUS OF A 3-MEV VAN DE GRAAFF ACCELERATOR. G. Bougnot, R. Galiana, J. Samueli, and A. Sarazin (Institut d'Etudes Nucléaires, Algiers). J. phys. radium, 22: Suppl. to No. 11, 145A-8A (Nov. 1961). (In French)

An electrostatic apparatus allowing proton pulses, whose duration is less than a nanosecond, with a repetitive rate of 10 MHz, is described. The average current reached is about 0.1 μa. The time measurement electronic circuits related to the pulse system are also described. (auth)

13751 CROSS SECTION MEASUREMENTS FOR 14.7-MEV NEUTRONS. UTILIZATION OF THE α PARTICLE ASSOCIATED WITH THE NEUTRON IN THE REACTION $T(d,n)He^4$. D. Didier (Commissariat à l'Énergie Atomique, [Paris]). J. phys. radium, 22: Suppl. to No. 11, 149A-52A (Nov. 1961). (In French)

Neutron cross section measurements are greatly facilitated by the use of the associated α particle in the 14 Mev region. The experimental assembly is first described, and some examples of the measurements obtained with this

method are given. Some experiments in progress are also described. The total cross sections and nonelastic collision cross sections are studied in detail. The differential elastic cross sections and the measurement of the neutron transmission spectrum are also considered. (auth)

13752 INTENSE BEAM OF μ^- MESONS OF HIGH PURITY. A. Citron, C. Delorme, F. J. M. Farley, L. Goldzahl, J. Heintze, E. G. Michaélis, M. Morpurgo, H. Oeveras, and Yu. Shcherbakov (Shtcherbakov) (C.E.R.N., Geneva). J. phys. radium, 22: Suppl. to No. 11, 152A-5A (Nov. 1961). (In French)

A focusing and analyzing device, consisting of 24 quadrupole lenses with an alternating gradient magnet, was constructed near the C.E.R.N. synchrocyclotron. It provides strong fluxes of μ^- mesons (about 10^4 μ^-/sec on a 10 × 10 cm^2 target) with a low π meson contamination (1% or less) for high and low energy. (auth)

13753 FORM DISCRIMINATION. APPLICATION TO THE STUDY OF NEUTRON-PROTON ELASTIC SCATTERING AT 14.5 MEV. G. Ambrosino, F. Cambou, and J. P. Crettez (Laboratoire Maurice-de-Broglie, Paris). J. phys. radium, 22: Suppl. to No. 11, 156A-8A(Nov. 1961). (In French)

The decay of luminous pulses, produced in inorganic or organic scintillators by ionizing particles, differs with the nature of the particles: two procedures are described allowing the selection of pulses created by protons or α particles, in the presence of pulses due to a flux of γ rays. (auth)

13754 FAST NEUTRON SPECTROMETER WITH LITHIUM-6 AND SILICON DIODES. J. Bok, B. De Cosnac, J. P. Noel, R. Schuttler, M. Lott, J. P. Millot, and J. Rastoin (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). J. phys. radium, 22: Suppl. to No. 11, 158A-62A(Nov. 1961). (In French)

Using the reaction $Li^6(n,\alpha)He^3$ with q = 4.78 Mev and measuring the added energies of the α particle and of the triton, the energy of the incident neutron is deduced. The apparatus is made of a thin Li^6F target between two surface barrier diodes, able to measure the energy of the charged particles issuing from the LiF. The theoretical resolution of such a spectrometer was calculated and the apparatus tested, both for thermal neutrons and for 2.5, 3.6, and 4.7 Mev neutrons, produced by a 600 kev accelerator. (auth)

13755 REALIZATION AND STUDY OF THE PROPERTIES OF HEAVY PARTICLE DETECTORS WITH SURFACE BARRIER. A. Coche and P. Siffert (Centre de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: Suppl. to No. 11, 162A-4A(Nov. 1961). (In French)

Gold–silicon surface barrier counters for heavy particles were built. The method of construction is described, and the influence of a number of factors which could change the properties of the detector is studied. Full width at half maximum (FWHM) of Po^{210} alpha rays was obtained below 30 kev for a sensitive area of 7 mm^2. The principal characteristics are given: reverse current, resolution, linearity, and radiation damage induced by alpha particles. (auth)

13756 PARTICLE DISCRIMINATION WITH THE AID OF A SCINTILLATION COUNTER. G. Walter and A. Coche (Centre de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: Suppl. to No. 11, 165A-7A(Nov. 1961). (In French)

Use is made of the difference in stilbene or plastic fluorescent decay times to identify particles of different ionization power. The circuit design allows one, for example, to obtain the Po^{210} α spectrum with rejection of 97% of the Bi^{207} electron spectrum. The system is based on the properties of the pulse generated across the anode load of the photomultiplier after differentiation. Some circuits were designed in order to improve the discrimination ratio and time resolution. Results of experiments with separation of protons and gammas, alphas and electrons, are presented. (auth)

13757 APPARATUS PERMITTING THE ANALYSIS OF THE PULSE OF A FAST PHOTOMULTIPLIER. G. Pfeffer, G. Laustriat, and A. Coche (Centre de Recherches Nucléaires, Strasbourg). J. phys. radium, 22: Suppl. to No. 11, 168A-70A(Nov. 1961). (In French)

An electronic circuitry permitting the integrated pulse from a fast photomultiplier (Dario 56 AVP) to be reproduced in every detail was constructed. Very accurate results were obtained in this analysis owing to a slotted delay line. This device is used for the measurement of nanosecond decay time in liquid or plastic scintillators. (auth)

13758 FAST DETECTOR FOR INTERMEDIATE NEUTRONS (1 TO 100 KEV). UTILIZATION IN TIME-OF-FLIGHT SPECTROMETER. A. Perrin (Commissariat à l'Énergie Atomique, [Paris]). J. phys. radium, 22: Suppl. to No. 11, 170A-2A(Nov. 1961). (In French)

B^{10} and Li detectors are studied in order to determine their efficiency for 1 to 100 kev neutron energies and their response time. Curves that show the variation of the efficiency (6% for thermal neutrons) as a function of neutron energy are given. The use of these detectors in a "time of flight" spectrometer allows a resolving time of 8 ns for neutrons from the $T(p,n)He^3$ reaction to be obtained. (auth)

13759 LUMINOUS PULSE GENERATOR IN THE MILLIMICROSECOND REGION AT HIGH RATE OF RECURRENCE. UTILIZATION FOR THE STUDY OF THE FATIGUE OF PHOTOMULTIPLIERS. Pierre Cachon and Armand Sarazin (Institut d'Etudes Nucléaires, Algiers). J. phys. radium, 22: Suppl. to No. 11, 173A-4A(Nov. 1961). (In French)

The response of photomultipliers exposed to luminous pulses of constant amplitude, of several nanosecond duration, and in which the repetition rate can attain 10^7/second was studied. These pulses are produced by excitation of the fluorescence of a special cathode tube. The anode sensitivity measurements made as a function of the repetition rate have permitted the different origins of its variation to be dissociated: that caused by the modification of the distribution of the interdynode potential, that caused by the effect of space charge in the last stages, and that caused by dynode fatigue. (tr-auth)

13760 THE POSSIBILITY OF THE UTILIZATION OF A PROPANE BUBBLE CHAMBER FOR THE STUDY OF NUCLEAR REACTIONS PRODUCED BY PROTONS PRODUCED BY THE ORSAY SYNCHROCYCLOTRON. T. Yuasa, J. Dufournaud, A. Michalowicz, and M. Poulet (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). J. phys. radium, 22: Suppl. to No. 11, 175A-7A (Nov. 1961). (In French)

Adjustment and studies of some operating characteristics of a 6-liter propane bubble chamber for researches in nuclear reactions induced by the nucleons having energy between 70 and 135 Mev are reported. (auth)

13761 RANGE-ENERGY CURVES OF α PARTICLES IN ALUMINUM. Claude Gérardin, Roland Bilwes, and Denise Magnac-Valette (Centre de Recherches Nucléaires,

Strasbourg). J. phys. radium, 22: Suppl. to No. 11, 177A-8A(Nov. 1961). (In French)

The value of dE/dx was measured for α particles between 10 and 14 Mev in Al. The agreement with Whaling's theoretical values is good. Aron's absolute ranges around 4 Mev seem better than Whaling's values. (auth)

13762 DETERMINATION OF RADON AND THORON CONTAINED IN ATMOSPHERIC AIR. APPLICATION TO THE STUDY OF THE RADIOACTIVE EQUILIBRIUM BETWEEN THESE GASES AND THEIR DESCENDANTS. Jacques Fontan, Daniel Blanc, Michel Bonnafous, and André Bouville (Faculté des Sciences, Toulouse, France). J. phys. radium, 22: Suppl. to No. 11, 179A-81A(Nov. 1961). (In French)

The installation used to measure the radon and thoron concentration of the air is described. The characteristics of the installation and its sensitivity for these two gases were determined. A direct measurement of the activity of atmospheric aerosols was made. A comparison of the results showed that radioactive equilibrium is rarely attained. (tr-auth)

13763 DESCRIPTION OF A SMALL-ANGLE X-RAY DIFFRACTION CAMERA WITH LINEAR COLLIMATION. V. Luzzati and R. Baro (Centre de Recherches sur les Macromolécules, Strasbourg). J. phys. radium, 22: Suppl. to No. 11, 186A-8A(Nov. 1961). (In French)

A small angle x-ray diffraction camera is described, which makes use of a monochromatic focused beam issuing from a bent quartz monochromator. (auth)

13764 SIMPLE PULSING METHOD OF AN ELECTROSTATIC ACCELERATOR WITH HIGH FREQUENCY ION SOURCE. G. Grunberg (Centre d'Etudes Nucléaires, Grenoble, France). J. phys. radium, 22: Suppl. to No. 11, 194A-8A(Nov. 1961). (In French)

A beam pulsing system for a 150 kv ion accelerator with an R. F. type source is described. The pulses are obtained by screen modulation of the R. F. oscillator. The characteristics of the apparatus are as follows: pulse length, 4 μs to 2300 μs (continuously adjustable); repetition rate, 13 cs to 20 kcs (continuously adjustable); rise time of the target current, 2 μs; decay time of the target current, 3 μs; and pulse current amplitude, 1.6 mamp. (auth)

13765 MULTICELLULAR IONIZATION CHAMBER FOR THE STUDY OF THE 150-MEV PROTON BEAM OF THE ORSAY SYNCHROCYCLOTRON. X. De Bouard (Faculté des Sciences, Orsay, France). J. phys. radium, 22: Suppl. to No. 11, 208A-10A(Nov. 1961). (In French)

A multicellular ionization chamber is described which is used for beam adjustments of the Orsay synchrocyclotron. This chamber consists of some thirty cells obtained by metallizing a mylar foil. It can be used in an intensity range from 10^8 to 10^{10} protons/cm^2/sec. (auth)

13766 EJECTION OF ELECTRONS FROM BARIUM OXIDE BY NOBLE GAS IONS. Yoshiyuki Takeishi (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). J. Phys. Soc. Japan, 17: 326-41(Feb. 1962). (In English)

Electron ejection from BaO by accelerated singly charged ions of noble gases (except Kr) is investigated experimentally. BaO crystals used for the measurements are of two kinds: those annealed at 850°C and those activated by glow discharge in a noble gas. Measurements of the total yield, γ, and of the energy distribution of ejected electrons are made for ions in the kinetic energy range from 30 to 600 ev. For each kind of the ion, γ increases remarkably with increasing kinetic energy of the ions, and at the same time the electron energy distribution spreads greatly. γ also depends on the state of the BaO surface; this occurs through a change in population of the low energy part of the ejected electrons. Reflection of primary ions as ions at the BaO surface is very small ($< 0.5\%$) for ionic energies less than 100 ev. A part of electrons ejected by slow ions can be accounted for by the theory of Auger electron ejection from the valence band of BaO. The enlargement of the electron energy distribution with increasing ion kinetic energy is explained by an increase in repulsive potential between O^{--} and the incoming ion. (auth)

13767 BLEACHING OF F-CENTERS AND FORMATION OF COMPLEX CENTERS IN GAMMA-IRRADIATED KCl AT ROOM TEMPERATURE. Noriaki Itoh and Tokuo Suita (Osaka Univ.). J. Phys. Soc. Japan, 17: 348-58(Feb. 1962). (In English)

The optical bleaching of F centers in gamma-irradiated KCl was measured. The amount of F centers which bleached quickly, denoted by N_q, was studied as a function of irradiation dose and bleaching temperature. It was found that N_q includes the decrease of F center concentration due to complex center formation and due to recombination with positive holes, that the latter part of N_q is closely related to the F centers formed in the first stage of gamma-irradiation, and that the complex centers are formed only by the bleaching of F centers formed in the second stage of irradiation. The rate of complex center formation by intermittent light pulses was studied; results indicate that the amount of complex centers formed by a given number of pulses depends on the time interval between successive light pulses. The relaxation time for the formation of complex centers was obtained from these results, and the activation energy (0.95 ± 0.2) ev was obtained. An analysis of the quickly-bleached part of the F center was attempted, taking into consideration that the F centers formed in the first and the second stages of irradiation have different bleaching characteristics and that complex centers are formed after some ionic processes when second-stage F centers are bleached. (auth)

13768 FLOW FORMATION IN COUETTE MOTION IN MAGNETOHYDRODYNAMICS. Masakazu Katagiri (Yamagata Univ., Yonezawa, Japan). J. Phys. Soc. Japan, 17: 393-6(Feb. 1962). (In English)

Flow formation in the Couette motion of an electrically conducting, viscous, and incompressible fluid in a transverse magnetic field is studied. The analysis is limited to the case of small magnetic Reynolds number. By the Laplace transform, expressions for the velocity distribution and skin friction are obtained. Numerical results show that the flow is retarded, and the skin friction increases by the effect of the magnetic field. At the commencement of motion, the manner of flow formation is hardly affected by the magnetic field. (auth)

13769 X-RAY INITIATED PHOTOCONDUCTIVITY OF CdS SINGLE CRYSTALS. Jiro Nishimura (Iwate Univ., Morioka, Japan). J. Phys. Soc. Japan, 17: 402-3(Feb. 1962). (In English)

When a large concentration of excess Cd is present in CdS crystals, linearity does not always hold in the relation between photocurrents and x-ray intensities. One photocurrent component is of fast rise and proportional to the x-ray intensities; the other is of slow rise and not proportional to the intensities. The latter component becomes larger as the concentration of contained Cd becomes larger. (L.N.N.)

13770 ON COLOUR CENTERS IN $ZrSiO_4$. On Matumura and Hiroshi Koga (Kyusyu Univ., Fukuoka). J. Phys. Soc. Japan, 17: 409(Feb. 1962). (In English)

Electron spin resonance of colored $ZrSiO_4$, attributable to the a center, was measured at room temperature and having the static magnetic field rotated within the 110 plane. A plot of the observed resonance field as a function of the angle between the magnetic field and the c axis of the crystal was made. Results were analyzed assuming that the magnetic centers have electron spin S = 1, that they are in a crystalline field of axial symmetry, and that there are two inequivalent centers, the symmetry axes of which make angles of about $+55 \pm 5$ and $-55 \pm 5°$ with the c axis, respectively. (L.N.N.)

13771 DISSOCIATION OF DIATOMIC MOLECULES CONSIDERED AS DIFFUSION IN PHASE SPACE. Thor A. Bak and Knaud Andersen. Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd., 33: No. 7, 1-22(1961). (In English)

Dissociation of diatomic molecules is considered as the escape of a classical particle from a potential minimum due to its Brownian motion. The criterion for the reaction is taken to be the annihilation of the particle at a certain energy. For this model, the Kramers equation is set up and solved exactly for potentials of the form $V = C|r|^n$, and the rate constant for escape from the potential minimum is found. It is also shown how the rate constant may be obtained from a variational principle; as an example, the rate of escape from a Morse potential is found. The results obtained agree with machine calculations. An attempt to justify the Kramers equation in the limit of weak interaction by deriving it directly from the Liouville equation is presented. It is shown that the equation obtained deviates significantly from the Kramers equation, except for the case of a harmonic oscillator molecule. Rate constants thus obtained for the rate of escape of a particle from deep potentials are almost identical with those derived from the theory of Kramers. (auth)

13772 DESCENT OF PARTICLES AND MOLECULES THROUGH THE UPPER ATMOSPHERE. John R. Banister and H. L. Davis (Sandia Lab., Albuquerque, N. Mex.). Phys. Fluids, 5: 136-41(Feb. 1962).

The descent of small particles or heavy molecules through a stagnant exponential atmosphere was studied by numerical analysis. Both gravitational fall and molecular diffusion are taken into account. It is found that material injected in an arbitrary but horizontally uniform configuration assumes a constant profile which descends through the atmosphere at the fall rate of particles located at the maximum concentration. Analytic expressions are given which describe the profile descent rate, the constant-profile shape, and the constant-profile assemblage criterion. The material retention of an intervening turbulent layer in the atmosphere is examined; it is found that the later history of material is little affected by such a layer. (auth)

13773 FALL OF SMALL PARTICLES THROUGH THE UPPER ATMOSPHERE: AN ANALYTICAL TREATMENT. Kenneth D. Granzow (Sandia Lab., Albuquerque, N. Mex.). Phys. Fluids, 5: 142-3(Feb. 1962).

A time-dependent solution of the equation describing the fall of small particles through an infinite exponential atmosphere $(\partial c/\partial t) - (\partial/\partial x)\,[(K_1/\rho)\,(\partial c/\partial x) + (K_2/\rho)\,c] = 0$, where $\rho = \rho_0 e^{-x/\lambda}$, is found for an arbitrary initial distribution of particles. Qualitative characteristics of the solution including the agreement between this analytic solution and the numerical solutions of Banister and Davis are discussed. (auth)

13774 HIGH-TEMPERATURE TRANSPORT PROPERTIES OF DISSOCIATING HYDROGEN. J. T. Vanderslice, Stanley Weissman, E. A. Mason, and R. J. Fallon (Univ. of Maryland, College Park). Phys. Fluids, 5: 155-64(Feb. 1962).

The transport properties of dissociating hydrogen gas were calculated from 1,000 to 15,000°K with the assumption of no ionization or electronic excitation. The rigorous kinetic-theory formulas, which were recently modified to take into consideration the multiplicity of interaction curves, were used in the calculations. The transport coefficients at each temperature are tabulated as a function of composition rather than pressure for reasons of compactness and ease of interpolation. The fact that the collision integrals for the H–H interactions are abnormally large compared to those for the $H-H_2$ and H_2-H_2 interactions causes the transport properties of the mixtures to exhibit somewhat unusual behavior as a function of composition at constant temperature and pressure. Various approximate formulas for the calculation of transport properties of mixtures were checked against the results of the rigorous calculations. The errors in the viscosity and thermal conductivity are about 10%. For the Prandtl number, however, which involves the ratio of these coefficients, the error is only about 1%. (auth)

13775 NUCLEAR MAGNETIC DIPOLE COUPLING IN Al_2O_3. A. H. Silver, T. Kushida, and J. Lambe (Ford Motor Co., Dearborn, Mich.). Phys. Rev., 125: 1147-9 (Feb. 15, 1962).

An investigation of the five nuclear magnetic resonance lines in Al_2O_3 shows a partially resolved structure for each of the five lines. This structure can properly be described in terms of a two-spin Hamiltonian with dipole-dipole coupling. The dipole coupling constant d is 0.3998 kc/sec and the linewidths are approximately 10d. The analysis of the line shapes shows that the sign of the quadrupole coupling constant eqQ is positive. (auth)

13776 NUCLEAR RESONANCE OF ALUMINUM IN SYNTHETIC RUBY. C. M. Verber, H. P. Mahon, and W. H. Tanttila (Univ. of Colorado, Boulder). Phys. Rev., 125: 1149-57(Feb. 15, 1962).

The linewidth, line shape, and spin-lattice relaxation time T_1 were measured as a function of temperature in single crystals of $(Al^{27})_2O_3$ having nominal Cr_2O_3 concentrations of 0% and 0.01, 0.1, 1.5, and 4% by weight. Of the two important contributions to the linewidth, the nuclear spin-spin interaction is 7 gauss and temperature-independent. The contribution from the paramagnetic ions increased from zero at 300°K to as much as 42 gauss, depending upon concentration, temperature, and static magnetic field. An anomalous structure in the aluminum resonance was evident in both the steady-state and pulsed nuclear induction data. The $\frac{1}{2}$ to $-\frac{1}{2}$ transition has a splitting of 2.84 gauss with a $3\cos^2\theta - 1$ dependence on the angle between the c axis and H_0. The splitting is independent of the observation frequency and chromium ion concentration. T_1 was observed to vary from 150 sec to 1.5 msec as a function of ion concentration and temperature, and to vary in a manner not correctly given by existing theory. Many of the samples were observed to have a non-unique T_1. (auth)

13777 MÖSSBAUER STUDY OF ISOMER SHIFT, QUADRUPOLE INTERACTION AND HYPERFINE FIELD IN SEVERAL OXIDES CONTAINING Fe^{57}. G. Shirane (Westinghouse Electric Corp., Pittsburgh), D. E. Cox, and S. L. Ruby. Phys. Rev., 125: 1158-65(Feb. 15, 1962).

Mössbauer absorption by Fe^{57} was used to study isomer shift, quadrupole splitting, and hyperfine fields in several oxides containing iron. The established relations between

isomer shifts and ionic states of Fe were further confirmed by measurements on $Fe^{2+}Ti_2O_5$, $Fe_2^{3+}TiO_5$ and several other mixed oxides. By utilizing this relation, in turn, to identify the ionic states when these are in doubt, it was found that $(Fe,V)_2O_3$ incorporates the cation pair $Fe^{3+}-V^{3+}$, rather than $Fe^{2+}-V^{4+}$, and that "$SrFeO_3$" contains Fe^{4+} and Fe^{3+} in the ratio of 3:1. A well-defined quadrupole splitting was observed in $Fe_{1-x}O$ and in a number of the solid solutions (Fe,Mg)O, although their over-all symmetry is cubic. This is explained by the assumption of local asymmetry at the Fe nuclei caused either by vacancies or foreign ions. Hyperfine fields at the Fe^{3+} nuclei in $(Fe,Cr)_2O_3$, $(Fe,V)_2O_3$, and $(Fe,Al)_2O_3$ have values between 520 and 540 Kgauss when extrapolated to 0°K, and the results are discussed in conjunction with their magnetic properties. (auth)

13778 MAGNETISM OF KCl. E. Sonder (Oak Ridge National Lab, Tenn.). Phys. Rev., 125: 1203-8(Feb. 15, 1962).

At room temperature, KCl has a diamagnetic susceptibility of 1.04×10^{-6} cgs units per cm^3. The value at liquid nitrogen temperatures is ½% smaller. As the temperature is lowered further, a paramagnetic contribution inversely proportional to the temperature becomes apparent in additively or gamma-ray colored material. The magnitude of this paramagnetic contribution, which is proportional to the number of one-electron imperfection centers, is compared to the optical absorption of electron excess centers, to yield a value of 0.6 for the oscillator strength of the F band, and strong evidence that the M center is not paramagnetic. The results also indicate that the M center absorbs under the F band as well as in the M band. (auth)

13779 DE HAAS-VAN ALPHEN EFFECT IN BISMUTH–TELLURIUM ALLOYS. Daniel Weiner (Univ. of Chicago). Phys. Rev., 125: 1226-38(Feb. 15, 1962).

De Haas-van Alphen measurements were made on pure bismuth and several bismuth-tellurium alloys. It is found that the observed variation of external cross section and cyclotron effective mass with tellurium concentration and magnetic field orientation can be interpreted using a special case of Cohen's nonellipsoidal model of bismuth. The results indicate that there is a thermal energy gap between the conduction and valence band of about 0.046 ev in agreement with various optical experiments and that there are six electron "ellipsoids." The results also agree with a model for the hole band involving one light-hole ellipsoid and one heavy-hole ellipsoid and are used as evidence against some other possible models for the hole band. (auth)

13780 THEORY OF SUPERCONDUCTIVITY. S. H. Liu (International Business Machines Corp., Yorktown Heights, N. Y.). Phys. Rev., 125: 1244-8(Feb. 15, 1962).

Recently, Eliashberg derived the theory of superconductivity by the Green's function technique. The energy-gap equation was deduced by a self-consistent calculation. The result is similar to the integral equation of Bardeen, Cooper, and Schrieffer except that the effective electron interaction potential is different from the Bardeen-Pines potential as well as the Bogoliubov potential. These differences are discussed, and it is shown that the "dangerous terms" in the Bogoliubov theory may be calculated in a different manner. The compensation of these dangerous terms leads to the result of Eliashberg. Therefore, the self-consistent calculation of Eliashberg is but a different interpretation of Bogoliubov's idea. However, it is argued that the most reliable way of treating the problem should be the variational method because it gives the lowest ground-state energy. This method gives all the results of Bogoliubov in the lowest order of approximation, but is free from arbitrary interpretations. (auth)

13781 SECONDARY ELECTRON EMISSIONS FROM METAL SURFACE BY HIGH-ENERGY ION AND NEUTRAL ATOM BOMBARDMENTS. S. N. Ghosh and S. P. Khare (Univ. of Allahabad, India). Phys. Rev., 125: 1254-8 (Feb. 15, 1962).

To obtain γ_e for H_2^+ ion bombardment on metal targets, an expression for the secondary electron emission coefficient by fast positive ion bombardment is obtained after adopting a method of calculation similar to that employed by Sternglass. It is shown that the experimental values of γ_e for H_2^+ ion bombardment agree with the calculated values provided it is assumed that inside the target a hydrogen molecular ion is dissociated into a proton and a hydrogen atom, each having half the energy of the molecular ion. The dissociation cross section of a hydrogen molecular ion inside the target may be given by $\sigma_d = K\sqrt{T}$, where K = 1.2, σ_d is expressed in units of 10^{-17} cm^2, and T is in Mev. The secondary electron emission coefficient γ_e for high-energy hydrogen atom bombardment on a metal surface is also calculated and compared with experimental data. In the calculation, a neutral beam of hydrogen atoms is treated inside the target as composed of protons and electrons in addition to hydrogen atoms. Each of these three kinds of particles are capable of producing internal secondaries. A fair agreement between the calculated and observed values of γ_e for H^+, D^+, H_2^+, and H^0 bombardments was obtained. (auth)

13782 KNIGHT SHIFT AND QUADRUPOLE INTERACTION IN Tc METAL. William H. Jones, Jr. and Frederick J. Milford (Battelle Memorial Inst., Columbus, Ohio). Phys. Rev., 125: 1259-62(Feb. 15, 1962).

The nuclear magnetic resonance of the Tc^{99} nucleus in technetium metal was observed. The shape and position of the resonance are due to combinations of isotropic and anisotropic Knight shifts, first and second order quadrupole interactions, and dipolar broadening. The various contributions were separated by studying the characteristics of the resonance as a function of frequency. (auth)

13783 CALCULATION OF THE SUPERCONDUCTING STATE PARAMETERS WITH RETARDED ELECTRON-PHONON INTERACTION. P. Morel (French Embassy, New York) and P. W. Anderson. Phys. Rev., 125: 1263-71(Feb. 15, 1962).

The energy gap and other parameters of the superconducting state are calculated from the Bardeen-Cooper-Schrieffer theory in Gor'kov-Eliashberg form, using a realistic retarded electron-electron interaction via phonons and including the Coulomb repulsion. The solution is facilitated by observing that only the local phonon interaction, mediated entirely by short-wavelength phonons, is important, and that a good approximation for the phonon spectrum is therefore an Einstein model rather than Debye model. The resulting equation is solved by an approximate iteration procedure. The results are similar to earlier gap equations but the derivation gives a precise meaning to the interaction and cutoff parameters of earlier theories. The numerical results are in good order-of-magnitude agreement with the observed transition temperatures but lead to an isotope effect at least 15% less than the accepted $-\frac{1}{2}$ exponent (T_c proportional to $M^{-\frac{1}{2}}$). Also, the present theory predicts that all metals should be superconductors, although those not observed to do so would have remarkably low transition temperatures. (auth)

13784 EFFECT OF AN IMPURITY LAYER ON SURFACE WAVES. Harvey Kaplan (Syracuse Univ., N. Y.). Phys. Rev., 125: 1271-6(Feb. 15, 1962).

The effects of a homogeneous impurity mass layer on the surface waves of a semi-infinite monatomic square lattice with nearest and next nearest neighbor central springs are studied. In the long-wavelength limit, the impurity layer does not alter the surface waves from those of a pure semi-infinite lattice. However, depending upon the ratio of the impurity mass to the host mass, and for wavelengths shorter than a critical wavelength, the long-wavelength surface wave may disappear and new surface waves with frequencies either higher or lower than the spectrum of the pure infinite lattice may appear. The relationship of this model to the analogous one- and three-dimensional problems is discussed. This theory is expected to be applicable to problems such as the effect of an oxide layer on the surface vibrations of a crystal. (auth)

13785 ANTIFERROMAGNETIC STRUCTURE OF $CrVO_4$ AND THE ANHYDROUS SULFATES OF DIVALENT Fe, Ni, AND Co. B. C. Frazer and P. J. Brown (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 125: 1283-91 (Feb. 15, 1962). (BNL-5681)

The antiferromagnetic structures of $CrVO_4$, $FeSO_4$, $NiSO_4$, and $CoSO_4$ were determined from neutron diffraction data collected from polycrystalline samples. All of these compounds have the same orthorhombic crystal structure. In this structure, the magnetic ions form face-centered sheets which stack at d_{002} intervals in the c direction. The magnetic structure found for $CrVO_4$ consists of ferromagnetically ordered sheets which stack antiferromagnetically. The single spin direction is found to be inclined at angles $\Phi_a = 27 \pm 15°$, $\Phi_b = 64 \pm 10°$, and $\Phi_c = 81 \pm 15°$ with the crystallographic axes. A somewhat more logical spin orientation, which is close to being within experimental error, would be parallel to the a axis. The Cr^{3+} moment at 4.2°K is $2.1 \pm 0.2\ \mu_B$. The magnetic structures of $FeSO_4$ and $NiSO_4$ both have antiferromagnetic sheets with ferromagnetic coupling between the sheets. In both cases, the spin direction is parallel to the b axis. The moments at 4.2°K are $4.1 \pm 0.4\ \mu_B$ for Fe^{2+}, and $2.1 \pm 0.1\ \mu_B$ for Ni^{2+}. In $CoSO_4$ there is also antiferromagnetic ordering within each sheet, but the coupling between sheets does not lead to a collinear spin structure. Instead, there are two spin directions that alternate in successive sheets. The spin vectors are found to lie in the YZ plane at alternately clockwise and counterclockwise angles of $25 \pm 2°$ from the b axis as translations are made along the c axis. The Co^{2+} moment at 4.2°K is $3.3 \pm 0.2\ \mu_B$. This magnetic structure found for $CoSO_4$ is very similar to a structure predicted recently for $CuCl_2 \cdot 2H_2O$ by Moriya on the basis of anisotropic superexchange calculations. (auth)

13786 ALIGNMENT OF THE H_2^+ MOLECULAR ION BY SELECTIVE PHOTODISSOCIATION. [PART] I. H. G. Dehmelt and K. B. Jefferts (Univ. of Washington, Seattle). Phys. Rev., 125: 1318-22(Feb. 15, 1962).

On the basis of experimental results obtained by Linlor et al., Fischer, and in this laboratory, demonstrating photodissociation time constants as short as 0.1 sec and trapping times as long as several seconds as practical for the H_2^+ molecular ion, the feasibility is discussed theoretically of a novel technique to align trapped molecular ions and also to monitor the alignment by selective photodissociation. First, the limiting case of no electronic and nuclear spins and very large rotational quantum numbers is treated, based on the concept that the photodissociation rate R is proportional to the average squared component of the electric light vector perpendicular to the axis of molecular rotation. This angular dependence of R when a bunch of ions created by a short electron bombardment pulse is subsequently irradiated causes the ions in certain magnetic sublevels to decay much more slowly than others. Consequently when conditions for the preservation of alignment are favorable, the sample becomes increasingly aligned. Furthermore, since a partially aligned sample photodissociates more slowly than an unaligned one, more molecular ions $\bar{N}$ will remain when alignment is allowed to develop than when it is continuously destroyed, resulting in only N ions. Next, the nuclear and electronic spins are taken into account and numerical values for the dissociation rates of the 30 magnetic sublevels for the first three rotational states of the H_2^+ ion are evaluated for linear light polarization. One sees that on the basis of a sample of 10^9 H_2^+ ions decaying due to photodissociation to 2×10^7 ions, one might expect an optimum signal $(\bar{N} - N)/N \approx 0.25$ compared to a statistical uncertainty of about 0.0003 for two consecutive pulses. The possibilities inherent in the scheme to observe the r-f spectrum of H_2^+ are pointed out. (auth)

13787 FERMION ENSEMBLES OF MAXIMUM ENTROPY. Martin C. Gutzwiller (International Business Machines Research Lab., Adliswil-Zurich). Phys. Rev., 125: 1455-60(Mar. 1, 1962).

Ensembles of particles obeying Fermi-Dirac statistics are considered from a point of view analogous to that found in work on classical particle statistics. The density functions ρ_n are defined for n much smaller than the average number of particles in the ensemble. Since the knowledge of only a few ρ_n is sufficient for the computation of most averages of physical interest, it is important to compare different ensembles with the same density functions, say ρ_1 and ρ_2. The ensemble with the larger entropy is constructed as being the most significant. A number of simple examples are briefly considered. (auth)

13788 EXACT EVOLUTION OF REDUCED DISTRIBUTION FUNCTIONS IN A HOMOGENEOUS DENSE CLASSICAL FLUID. Frank C. Andrews (Univ. of California, Berkeley). Phys. Rev., 125: 1461-9(Mar. 1, 1962).

The exact evolution of reduced distribution functions is studied for a homogeneous dense classical fluid by methods equivalent to the diagram technique. No diagrams or Fourier expansions are used, however. So long as only short-range order is present in the fluid, exact equations for the evolution of the momentum distribution function and for reduced s-particle distribution functions are obtained. The equations are seen to be non-Markovian in a sense explicitly related to the finite duration of a collision. Simple Markovian equations—a generalized master equation for momenta and a functional equation for correlations—result only when the momentum distribution changes negligibly in times of the order of the duration of a collision. (auth)

13789 APPROACH TO EQUILIBRIUM IN A DENSE CLASSICAL FLUID. Frank C. Andrews (Univ. of California, Berkeley). Phys. Rev., 125: 1469-72(Mar. 1, 1962).

The equation for the exact evolution of the momentum distribution function of a homogeneous dense classical fluid is studied. The Markovian form of this equation is found to drive the momentum distribution monotonically to an arbitrary function of the kinetic energy of the system. This function must be canonical if it factorizes in momentum space. Incorporation of the non-Markovian effects in the evolution equation through a simple approximation does not destroy the approach to equilibrium. Since reduced s-particle distribution functions are functionals of the momen-

tum distribution, they also monotonically approach equilibrium. (auth)

13790 EVOLUTION OF REDUCED DISTRIBUTION FUNCTIONS FOR INHOMOGENEOUS DENSE CLASSICAL FLUIDS. Frank C. Andrews (Univ. of California, Berkeley). Phys. Rev., 125: 1473-7(Mar. 1, 1962).

The evolution of reduced distribution functions is studied for an inhomogeneous dense classical fluid by methods used to study homogeneous fluids. So long as only short-range order is present in the fluid and the variation in properties caused by the inhomogeneity is negligible over distances of the order of the region of a collision, then the evolution equations for the one-particle and s-particle distribution functions are obtained. The equations take a simple Markovian form if the one-particle distribution changes negligibly in times of the order of the duration of a collision. The operators involved in the evolution equations are studied. Their physical meaning and relationship to the classical Boltzmann equation are considered. (auth)

13791 THERMODYNAMIC BEHAVIOR OF LIQUID HELIUM-THREE IN ITS POSSIBLE SUPERFLUID PHASE. [PART] I. Toshio Soda (Univ. of California, Berkeley) and Ramabadhra Vasudevan. Phys. Rev., 125: 1484-93(Mar. 1, 1962).

The thermodynamic behavior of liquid He^3 in its possible superfluid phase is investigated. It is suggested that such a correlated phase can exist at very low temperatures as a result of the existence of attractive D-state interactions near the Fermi surface. The free energy and the energy gap of the system for D-state interactions corresponding to different pure azimuthal modes are calculated at different temperatures. It is found that $l = 2$, $m = 2$ and $l = 2$, $m = 1$ modes correspond to the lowest free energy of the system near the critical temperature. In the intermediate range of temperatures the free-energy curves for the two modes, when the computations are made numerically, are very nearly the same. It can be shown by an analytical method that they are actually identical. The $l = 2$, $m = 0$ mode yields a higher free energy for all temperatures less than the critical temperature. The mixing of modes is investigated near the critical temperature. Any linear combination of all the modes $l = 2$, $m = 0, 1, -1, 2,$ and -2 does not seem to lead to a lower free energy than that of the $l = 2$, $m = \pm 2$, and $m = \pm 1$ modes. The correlation lengths at different temperatures are also analyzed. The specific heat and entropy curves for the $l = 2$, $m = 2$ mode are given. (auth)

13792 TRANSPORT PROPERTIES OF LIQUID He^3. Daniel Hone (Univ. of Illinois, Urbana). Phys. Rev., 125: 1494-5(Mar. 1, 1962).

Theoretical estimates of transport coefficients in liquid He^3 at various pressures are made. The experimental values of the parameters which enter the Landau phenomenological theory are specified, and the importance of using the correct forward scattering amplitude rather than a self-energy in the estimate of transition probabilities is noted. The results are tabulated, along with empirical values of the parameters of the liquid. (auth)

13793 EXTREME ULTRAVIOLET ABSORPTION BY LITHIUM FLUORIDE. A. Milgram and M. Parker Givens (Univ. of Rochester, N. Y.). Phys. Rev., 125: 1506-9 (Mar. 1, 1962).

A study was made to determine the absolute value of the absorption coefficient for lithium fluoride between 10 and 110 ev. The first exciton level in the fundamental absorption was found to be at 12.9 ev. Absorption structure attributed to the fluorine 2s electrons and lithium 1s electrons was observed. The energy band gap was estimated to be less than 14 ev. The absorption structure associated with the LiK electrons was found at energies corresponding to transitions by the 2s electrons of the free Li^+ ion. A duplication of this structure at a higher energy suggested the possibility that a multiple process was involved in the photon absorption. (auth)

13794 ULTRAVIOLET ABSORPTION OF KI DILUTED IN KCl CRYSTALS. Herbert Mahr (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 125: 1510-16(Mar. 1, 1962).

The absorption of KI diluted in KCl single crystals was studied for concentrations of 10^{-3} to 10^{-5} mole fraction KI in the temperature range from 80 to 700°K. The exact shape of the long-wavelength absorption peak, which was Gaussian around the maximum and exponential at the edge, was measured quantitatively over four orders of magnitude. The total integrated absorption was proportional to the iodide concentration, which was determined chemically. In the limit of high temperatures the half-width of the band was proportional to the square root of the temperature and the edge followed Urbach's law. Deviations at low temperatures were shown to arise from zero-point oscillations. The results were compared with models for localized excitons. (auth)

13795 NUCLEAR SPIN ABSORPTION SPECTRA IN SOLIDS. A. G. Anderson (International Business Machines Research Lab., San Jose, Calif.). Phys. Rev., 125: 1517-27(Mar. 1, 1962).

Nuclear magnetic spin absorption spectra in both parallel and perpendicular ac and dc magnetic fields are reported for lithium nuclei in lithium metal. This is a case in which the predominant interactions are the Zeeman interaction of the nuclear magnetic moment with the dc field and the magnetic dipole-dipole interaction between nuclei in fixed lattice positions. For an applied dc field, H_0, the spectrum consists of absorption around zero frequency, around $\omega = 2\gamma H_0$, and around $\omega = 2\gamma H_0$. Linewidths and relative amplitudes observed experimentally are in agreement with the theory, which predicts linewidths of approximately the same magnitude for all lines and line amplitudes which vary as H_0^{-4}, H_0^0, or H_0^{-2}. At applied dc fields that are large compared with the internal magnetic dipole-dipole fields an additional absorption is observed for the parallel-field case at very low frequencies; this is attributed to the relatively long time required for establishment of internal equilibrium at these fields. Absorption spectra are reported for lithium-magnesium alloys. In these alloys addition of magnesium produces electric quadrupole broadening of the lithium absorption spectra. The zero-field absorption spectrum of copper is also reported. (auth)

13796 FAR-INFRARED FERROELECTRIC VIBRATION MODE IN $SrTiO_3$. A. S. Barker, Jr. and M. Tinkham (Univ. of California, Berkeley). Phys. Rev., 125: 1527-30(Mar. 1, 1962).

The real and imaginary parts of the dielectric constant of $SrTiO_3$ are obtained for the region 2.5 to 3000 cm^{-1} from an analysis of the reflectivity. The imaginary part exhibits a very strong peak at 100 cm^{-1} at room temperature, which shifts to 40 cm^{-1} at 93°K. This mode is of sufficient strength to account for more than 90% of the low-frequency dielectric constant. The accompanying dispersion of the real part of the dielectric constant is of resonant form. The connection of this mode with theory of ferroelectricity is discussed. (auth)

13797 PARAMAGNETIC RESONANCE OF THE COBALT ION IN RUTILE SINGLE CRYSTAL. E. Yamaka

and R. G. Barnes (Ames Lab., Ames, Iowa). Phys. Rev., 125: 1568-9(Mar. 1, 1962). (IS-364)

The electron paramagnetic resonance of Co^{2+} in single-crystal rutile (TiO_2) is investigated at 3-cm wavelength and 4.2°K. The angular dependence of the resonance pattern indicates that the Co^{2+} ion enters substantially for the Ti^{4+} ion in the lattice. Strongly anisotropic values of the splitting factor g and hfs constant A are obtained, which may be understood in terms of a fairly large charge transfer to the surrounding ions. (auth)

13798 PROBLEM OF ANOMALOUS RESISTIVITY IN PLUTONIUM. R. Smoluchowski (Princeton Univ., N. J. and Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 125: 1577-81(Mar. 1, 1962).

The anomalous resistivity of Pu is interpreted in terms of interband scattering. It is shown that a reasonable band structure can account for the observed resistivities in alpha and in (stabilized) delta Pu. The behavior of the anomaly as a function of alloying additions is also made understandable. (auth)

13799 COLOR CENTERS IN CsCl-TYPE ALKALI HALIDES. Herbert Rabin and James H. Schulman (Naval Research Lab., Washington, D. C.). Phys. Rev., 125: 1584-96(Mar. 1, 1962).

A study of x-ray-induced color centers in the CsCl-type alkali halides is made at room, liquid nitrogen, and liquid helium temperatures. The gross features of this coloration are similar to those observed in NaCl-type halides, namely a principal absorption band in the visible portion of the spectrum with other absorptions at both longer and shorter wavelengths. The absorption spectra observed vary with the temperature of irradiation; the bands show characteristic thermal shifting and broadening, bleach under both thermal and optical excitation, and demonstrate much of the usual color-center behavior. At the same time some characteristics of the cesium halides appear to be unique, in particular the multiplicity in structure which makes its appearance in the principal absorption bands of CsCl and CsBr at liquid helium temperature. Since the principal absorption gives evidence of being associated with the F center, one possible explanation of the component structure is that it arises from higher excited states of the F center. (auth)

13800 HIGH-ENERGY INTERFERENCE EFFECT OF BREMSSTRAHLUNG PRODUCTION IN A SINGLE CRYSTAL OF SILICON. A. N. Saxena (Stanford Univ., Calif.). Phys. Rev., 125: 1720-6(Mar. 1, 1962).

In a study of the interference effect of the bremsstrahlung production by 575-Mev electrons in a single crystal of silicon, the ratio of the charges collected in the two halves of a double ion chamber were used to detect the enhancement of the soft component of the bremsstrahlung. The data, presented in the form of a three-dimensional plot of the ratio vs. the angles of rotation between the lattice normal and the electron beam about the horizontal and the vertical axes, clearly showed the enhancement. Comparison of the experimental result and the theory showed agreement. The resolution was poor; hence the central minimum predicted by the theory could not be observed. (auth)

13801 SPIN SUSCEPTIBILITY OF NORMAL FERMION SYSTEMS. Ronald M. Rockmore (Brandeis Univ., Waltham, Mass. and RAND Corp., Santa Monica, Calif.). Phys. Rev., 125: 1778-84(Mar. 1, 1962).

The calculation of the induced spin density of a normal fermion system, such as the electron gas, in the limit of small wave numbers, is carried beyond the random phase approximation (R.P.A.) by the method of canonical transformation so as to include the first non-R.P.A. corrections. An expression for the induced spin density in the same limit, exact to all orders of particle-particle coupling, is then derived by more general methods of many-body perturbation theory. This spin density depends only on the knowledge, to all orders of interparticle coupling, of the effective mass and the forward scattering of quasi-particles at the Fermi surface, and also yields the results of the extended R.P.A. on appropriate expansion. In the limit of zero wave number, the resulting expression for the magnetic susceptibility is found identical with that deduced by Landau from a phenomenological basis and may be regarded as a confirmation of the microscopic validity of the theory of the Fermi liquid. (auth)

13802 RADIAL ELECTRIC FIELD IN A REFLEX DISCHARGE. Francis F. Chen (Princeton Univ., N. J.). Phys. Rev. Letters, 8: 234-7(Mar. 15, 1962). (MATT-111)

The radial potential distribution in a hot-cathode reflex discharge is computed, and a scaling law is obtained. Time averaged properties of the discharge are considered. Diagrams of typical radial profiles and the idealized geometry and principal particle currents in the discharge are presented. (L.N.N.)

13803 MAGNETOHYDRODYNAMIC EQUATIONS FOR FINITE LARMOR RADIUS. K. V. Roberts and J. B. Taylor (Culham Lab., Abingdon, Berks, Eng.). Phys. Rev. Letters, 8: 197-8(Mar. 1, 1962).

Calculations using two-fluid magnetohydrodynamic equations (B. Lehnert, Phys. Rev. Letters 7: 442(1961)) appear to show cancellation of a stabilizing effect (M. N. Rosenbluth, et. al., Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg (1961)). It is shown that the cancellation resulted from using only the scalar pressure in the ion equation of motion. Derivations of additional factors using modifications to both the ion pressure tensor and Ohm's law are presented. (L.N.N.)

13804 SCATTERING OF PHONONS BY SPINS AT LOW TEMPERATURES. I. P. Morton and H. M. Rosenberg (Oxford Univ.). Phys. Rev. Letters, 8: 200-1(Mar. 1, 1962).

Interactions of spins and phonons are studied by investigating the lattice thermal conductivity of holmium ethyl sulfate crystals containing paramagnetic ions. Relations to applied magnetic fields and temperature are illustrated. (L.N.N.)

13805 UPPER LIMIT FOR QUASI-PARTICLE RECOMBINATION TIME IN A SUPERCONDUCTOR. D. M. Ginsberg (Univ. of Illinois, Urbana). Phys. Rev. Letters, 8: 204-7(Mar. 1, 1962).

In superconductors at finite temperatures, dynamic equilibrium exists; clothed electrons are continuously excited above the gap and recombine in pairs to fall below the gap. Rates of these processes are studied and discussed in terms of the mean time for recombination with any particular excited electron. Upper limits are obtained. (L.N.N.)

13806 CALCULATION OF THE QUASIPARTICLE RECOMBINATION TIME IN A SUPERCONDUCTOR. J. R. Schrieffer and D. M. Ginsberg (Univ. of Illinois, Urbana). Phys. Rev. Letters, 8: 207-8(Mar. 1, 1962).

Phonon emission effects on electron-pair recombination in superconductors are considered. The Bardeen-Cooper-Schrieffer theory (Phys. Rev., 108: 1175(1957)) is applied. At 1.44°K, a result one order of magnitude smaller than the experimental upper limit is obtained. (L.N.N.)

13807 ORIENTATION OF $(He^4)^+$ IONS BY EXCHANGE COLLISIONS WITH CESIUM ATOMS. H. G. Dehmelt and F. G. Major (Univ. of Washington, Seattle). Phys. Rev. Letters, 8: 213-14(Mar. 1, 1962).

Polarization of trapped $(He^4)^+$ ions was demonstrated by observing low-field Zeeman transitions. Creation and monitoring of the ions are described. The orientation and monitoring were accomplished by bombarding the trapped ions with a beam of optically oriented Cs atoms. Spin exchange and charge capture are described. (L.N.N.)

13808 THE DIELECTRIC CONSTANT OF LIQUID HELIUM. C. E. Chase (Massachusetts Inst. of Tech., Lexington), E. Maxwell, and W. E. Millett. Physica, 27: 1129-45(Dec. 1961). (In English)

The dielectric constant of liquid helium was measured between 1.4 and 4.2°K under the saturated vapor pressure with a resolution of approximately one part per million. When compared with direct measurements of the density, the results show that the polarizability is essentially independent of temperature; if this is assumed to be exactly true, they can be used to determine the density-temperature curve and the coefficient of thermal expansion. The density passes through a maximum about 5×10^{-3}°K above the γ point. As the γ point is approached from either side, the expansion coefficient tends logarithmically to minus infinity. This behavior is similar to that of the specific heat, and is consistent with thermodynamic relations applicable to a second-order phase transition. The specific heat ratio γ and the isothermal compressibility k_T were calculated within 0.05°K of the γ point. (auth)

13809 ON SUPERMOBILITY IN AN ISOTOPIC MIXTURE OF A HARD SPHERE BOSE AND FERMI GAS AT T = 0. E. G. D. Cohen and J. M. J. van Leeuwen (Universiteit, Amsterdam). Physica, 27: 1157-60(Dec. 1961). (In English)

The ground-state energy of a mixture of N_1 Bose molecules of mass $\underline{m}_1$ and N_2 Fermi molecules of mass $\underline{m}_2$ in a volume V at a given concentration $x = N_2/N$ and density $\rho = (N_1 + N_2)/V = N/V$ was calculated in terms up to the order of $\underline{a}^2$ for Bose particles and $\underline{a}^{5/2}$ for Fermi particles. Although the calculations are only valid in the limit of $\rho \ll 1$, other results were used in an attempt to incorporate some basic property of the system. The mixture exhibits phase separation only above a critical density. This is a direct consequence of the statistics of the particles and is to the first order in $\underline{a}$ independent of the mass ratio of the constituent particles. A state of supermobility at T = 0 for low concentration of the Fermi component occurs for all densities below a critical density, where phase separation interferes. This state depends, apart from the statistics of the particles, sensitively on the mass ratio of the molecules. (L.N.N.)

13810 SPECTRAL STRUCTURE OF DOUBLY AND TREBLY IONIZED HAFNIUM. P. F. A. Klinkenberg, Th. A. M. Van Kleef, and P. E. Noorman (Universiteit, Amsterdam). Physica, 27: 1177-88(Dec. 1961). (In English)

A level scheme is presented which accounts for more than 80% of the observed Hf III lines. All levels in the low even group and the odd group were given quantum assignments. The configurations involved are $5d^2$, 5d6s, $6s^2$, 5d6p, and 6s6p, with $5d^2\ F_2^3$ being the ground state of the ion. The only predicted level which could not be located, is $5d^2\ S_0^1$. Some assignments also were made in the high even system of levels, where fragments of 5d7s and 5d6d were detected. The ionization potential of Hf III is found to be 23.3 v. The fundamental levels of Hf IV were established. They leave most of the lines attributed to that spectrum, unexplained but account for the strongest and most characteristic ones. The ionization potential derived for Hf IV is 33.3 v. The structure of the two spectra is discussed in connection with related systems. (auth)

13811 ON THE SUMMATION OF LADDER DIAGRAMS IN THE THEORY OF SUPERCONDUCTIVITY. D. J. Kenworthy and D. Ter Haar (Clarendon Lab., Oxford). Physica, 27: 1189-92(Dec. 1961). (In English)

A proof is presented that the "ladder diagrams" which are made up entirely of vertices, in which a pair of quasi-particles is annihilated and another pair of different energy is created to take its place, do not lead to a divergence. (auth)

13812 ON THE STATISTICAL THEORY OF SUPERFLUIDITY. P. Résibois and I. Prigogine (Université Libre, Brussels). Physica, 28: 1-14(Jan. 1962). (In English)

A statistical theory of superfluidity in imperfect Bose gases is presented. It is shown that the density fluctuations that are linear in the creation and destruction operators of excitations correspond to the superfluid, while the fluctuations which are quadratic in these operators give rise to the normal fluid. A direct link is established between the two fluid model and the macroscopic occupation of the ground state. (auth)

13813 THE SECOND VIRIAL COEFFICIENTS OF THE HYDROGEN ISOTOPES BETWEEN 20 AND 70°K. H. F. P. Knaap, M. Knoester, C. M. Knobler, and J. J. M. Beenakker (Kamerlingh Onnes Laboratorium, Leiden). Physica, 28: 21-32(Jan. 1962). (In English)

The second virial coefficients of H_2, HD, and D_2 are measured at low densities at 20 to 70°K using a differential method. The measurements confirmed the results of isotherm determinations. At higher temperatures, agreement with existing data was found. (auth)

13814 A DERIVATION OF THE HYDRODYNAMIC EQUATIONS FROM THE EQUATIONS OF MOTION OF COLLECTIVE COORDINATES. D. W. Jepsen and D. Ter Haar (Clarendon Lab., Oxford). Physica, 28: 70-5(Jan. 1962). (In English)

The equations of motion of the Fourier components of the density are used to derive the hydrodynamic equations of continuity and of motion. A discussion of the quantum mechanical case is given. (auth)

13815 A NOTE OF KIHARA'S METHOD FOR CALCULATING TRANSPORT COEFFICIENTS OF A GAS. M. J. Offerhaus (Univ. of Wisconsin, Madison). Physica, 28: 76-9(Jan. 1962). (In English)

A comparison to Chapman's method is given for the viscosity and heat conductivity of a simple gas. The validity of the conclusion that Kihara's method gives more accurate results than Chapman's second approximation depends on the potential field and temperature range considered. (L.N.N.)

13816 ISOTOPE SHIFT IN THE CdI RESONANCE LINE λ 2288 Å. F. M. Kelly and E. Tomchuk (Univ. of Manitoba, Winnipeg, Can.). Proc. Phys. Soc. (London), 78: 1304-6(Dec. 15, 1961).

Isotope shifts in the singlet resonance line of CdI were observed. The line was excited by electron bombardment of an atomic beam, and the high resolution was obtained with a Fabry-Pérot interferometer. The shifts measured in this line (λ 2288 Å) are compared with those previously measured in the intercombination resonance line (λ 3261) to show that the specific mass effect is small. Comparisons

are made with similar measurements in magnesium, zinc, and strontium. (auth)

13817 DISPERSION RELATIONS FOR SUPERCONDUCTORS. A. W. B. Taylor (Univ. of Liverpool). Proc. Phys. Soc. (London), 78: 1372-83(Dec. 15, 1961).

The general macroscopic description of the electromagnetic behavior of superconductors and normal conductors is developed, and dispersion relations for the frequency dependent material functions are rigorously established. Expressions similar to sum rules of electromagnetic theory are derived. Ferrell's proof that the Meissner effect is a consequence of the energy gap is shown to be unsound. Using the complex surface impedance, it is shown macroscopically that as a consequence of the Meissner effect, the area under the absorptivity curve for a superconductor is less than for the normal state. (auth)

13818 A LOW TEMPERATURE ADIABATIC CALORIMETER FOR CONDENSED SUBSTANCES. THERMODYNAMIC PROPERTIES OF ARGON. P. Flubacher, A. J. Leadbetter, and J. A. Morrison (National Research Council, Ottawa). Proc. Phys. Soc. (London), 78: 1449-61(Dec. 15, 1961).

An adiabatic calorimeter was constructed to study properties of condensed substances 2 to 300°K. Two resistance thermometers were used, one of platinum for T > 11°K, and one of carbon for T < 11°K. The carbon thermometer was calibrated on the thermodynamic temperature scale by using the calorimeter vessel as a gas thermometer; subsequent absolute shifts of its resistance on cycling between room temperature and liquid helium temperatures were taken into account by calibrations against the platinum thermometer. Heat capacities of solid and liquid argon were measured between 2 and 86°K with accuracies to ±2% at the lowest temperatures, increasing to ±0.2% for T > 20°K but decreasing to ±0.5% at the highest temperatures. In conjunction with these measurements, vapor pressures were measured at 66 to 86°K. The heat of fusion was 284.5 ± 0.4 cal mole^{-1}, the triple point temperature 83.810°K, and the triple point pressure 516.86 ± 0.02 mm Hg. The impurity in the specimen of argon was 3 parts per million from a study of the melting range. Direct measurement of the heat of vaporization of the liquid indicated 1563.6 ± 4.6 cal mole^{-1} at 85.67°K, which corresponds to 1555.0 ± 4.6 cal mole^{-1} at the normal boiling point. (auth)

13819 THERMODYNAMIC PROPERTIES OF KRYPTON. VIBRATIONAL AND OTHER PROPERTIES OF SOLID ARGON AND SOLID KRYPTON. R. H. Beaumont, H. Chihara, and J. A. Morrison (National Research Council, Ottawa). Proc. Phys. Soc. (London), 78: 1462-81(Dec. 15, 1961).

Calorimetric methods were used to measure thermodynamic properties of solid and liquid krypton. Besides heat capacities and vapor pressures over a range of temperatures, the following were obtained: heat of fusion = 392.0 ± 2.3 cal mole^{-1}, T(tr.pt.) = 115.77$_6$°K, p(tr.pt.) = 548.7 ± 0.1 mm, heat of vaporization at 116.85°K = 2179.2 ± 0.9 cal mole^{-1} and at the normal boiling point = 2162 ± 1 cal mole^{-1}. Properties of solid argon and solid krypton were derived, in particular, the apparent Debye characteristic temperatures at 0°K and as a function of temperature, the heats of sublimation at 0°K, the static lattice energies and the zero point energies. Results of thermal measurements on the solids were correlated with expansivity and compressibility results, and inconsistencies were resolved. Calorimetric results are internally consistent. The shapes of curves of $\Theta_D(T)$ against temperature indicate that anharmonic contributions to the vibrational properties of solid argon and solid krypton are appreciable, particularly in the region $T > \Theta_0/10$. Below the melting points, C_p for argon and krypton increases rapidly with temperature. This is interpreted as an effect of vacancy formation in the solids. Enthalpies of formation are found to be 1280 ± 130 cal mole^{-1} for argon and 1770 ± 200 cal mole^{-1} for krypton. These are about two-thirds of values estimated from theory. An effect of vacancy formation may also be seen in vapor pressures. (auth)

13820 SPIN WAVES AND NEUTRON SCATTERING IN HEXAGONAL COBALT. G. G. E. Low (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 79: 473-8(Mar. 1, 1962). (AERE-R-3673)

The dispersion law for spin waves in hexagonal cobalt is calculated by the method of Holstein and Primakoff. As this crystal contains two atoms per unit cell an optical branch in the spectrum is found. The cross sections for inelastic neutron scattering by spin waves in cobalt are evaluated and discussed. (auth)

13821 SOME MEASUREMENTS OF PHONON DISPERSION RELATIONS IN IRON. G. G. E. Low (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 79: 479-86(Mar. 1, 1962).

The dispersion relations for phonons were measured for symmetry directions in a crystal of iron by means of neutron spectrometry. The time-of-flight technique was employed, the experiment being carried out on the twin-rotor spectrometer at Pluto. The dispersion curves obtained were fitted in each case by a cosine series expansion in which the coefficients are interplanar force constants of the crystal. Interatomic force constants consistent with the experimental data were also derived. (auth)

13822 THE FLUORESCENCE AND SCINTILLATION DECAY TIMES OF CRYSTALLINE ANTHRACENE. J. B. Birks (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 79: 494-6(Mar. 1, 1962).

The experimental data are analyzed with the following conclusions. The molecular decay time τ_0 of a thin anthracene crystal lamina at room temperature is 10 nsec. The thick crystal values are increased by self-absorption to 31.6 nsec (volume excitation, e.g. by γ rays), 24.1 nsec (surface excitation, e.g. by ultraviolet or α rays, and emission observed by transmission) and 19.4 nsec (surface excitation, and observation by reflection). Surface oxidation or reduction in crystal thickness yields lower values. For microcrystals of dimensions comparable with the exciton mean free path (~0.1 μ), the decay time is reduced below τ_0 due to premature conversion of excitons into photons at the crystal surface. (auth)

13823 ELECTRON EIGENSTATES IN A ONE-DIMENSIONAL LIQUID. A. P. Roberts and R. E. B. Makinson (Univ. of Sydney). Proc. Phys. Soc. (London), 79: 630-51 (Mar. 1, 1962).

Electron wave functions in a one-dimensional chain of δ-function potential wells, which have no long-range order or which have short-range disorder, are considered. By considering the 'pulling' of the wave function, conditions are found for its locking to the same near-periodicity as the chain. When the disorder is small enough and/or the wells strong enough, there is an energy gap in which there are no states. When the condition is nearly satisfied, or just outside such a gap, the density of states is very small and the corresponding wave functions are shown to have in general a single-peaked localization. Examination of computa-

tions of wave functions and eigenvalues in chains of length a thousand wells and upward supports the conclusions reached and shows the features predicted, in particular the strong localization. (auth)

13824 COLUMNAR RECOMBINATION LUMINESCENCE IN ARGON–NITROGEN MIXTURES. A. J. Tavendale (Univ. of Tasmania, Australia). Proc. Phys. Soc. (London), 79: 652-6(Mar. 1, 1962).

Luminescence from columnar electron–ion recombination following α particle and fission fragment ionization of an argon–nitrogen gas mixture is detected, and an estimate of the period for recombination made. In the presence of an electric field, a decrease in particle scintillation pulse-height from a photomultiplier tube is attributed to a loss of recombination luminescence by ion collection. The relative variation in the magnitude of this decrease with photomultiplier clipping time constant indicates that recombination occurs within 10^{-7} sec for α particles in Ar + 6% N_2 at two atmospheres pressure. (auth)

13825 CONDITIONS OF SLOW WAVE EXISTENCE IN AN ISOTROPIC PLASMA WAVEGUIDE. G. A. Postnov. Radiotekh. i Elektron., 6: 1325-7(Aug. 1961). (In Russian)

The problem of magnetic wave propagation in a plasma waveguide with a central dielectric plug was resolved, and the appearance of slow waves is explained by an uneven distribution of plasma. (tr-auth)

13826 PROPAGATION OF MICROWAVES IN A WAVEGUIDE CONTAINING CATHODE PARTS OF A GLOW DISCHARGE. A. M. Starik. Radiotekh. i Elektron., 6: 1533-9 (Sept. 1961). (In Russian)

The phase shift and attenuation produced by a glow-discharge cathode in a rectangular waveguide were determined as functions of helium and neon pressure. The influence of the waveguide cross section on the developed relations was analyzed, and the obtained data were interpreted on the basis of an inverse proportionality between cathode expansion and pressure. (tr-auth)

13827 DETERMINATION OF THE DEIONIZATION RATE OF CESIUM VAPORS IN A MAGNETIC FIELD USING A SPECTROSCOPE. Yu. M. Aleskovskii and V. L. Granovskii (Moscow State Univ.). Radiotekh. i Elektron., 6: 1590-2(Sept. 1961). (In Russian)

Cesium plasma recombination emission at 4940 Å, corresponding to electron capture by cesium at the $Cs6P_{\frac{1}{2}}$ level, was studied in order to verify the influence of magnetic field on charged particle recombination losses in disintegrating plasma. Intensity variations of the recombination emission in the deionization process are plotted as functions of time and magnetic field strength. At low pressures magnetic fields increase the number of charged particles that recombine with emission. (R.V.J.)

13828 SOME EFFECTS FOLLOWING DETECTION IN A GAS CHARGE. G. D. Lobov and V. I. Eremeev (Moscow Inst. of Power Engineering). Radiotekh. i Elektron., 6: 286-91(Feb. 1961). (In Russian)

Characteristics of super-high-frequency oscillations in a gas discharge are compared with the characteristics of a saturated glow. The effects were studied with helium and neon filled gas discharge tubes at various energies and discharge currents. (R.V.J.)

13829 RECOMBINATION RADIATION OF Cs PLASMA IN A MAGNETIC FIELD. Yu. M. Aleskovskii, V. L. Granovskii, and E. Mikhalets (Moscow State Univ.). Radiotekh. i Elektron., 6: 674-5(Apr. 1961). (In Russian)

The influence of a magnetic field on electron recombination with radiation emission in a stationary, low-pressure discharge in cesium vapor was studied by measuring the recombination intensity at the 4943 Å maximum, corresponding to electron capture at the $Cs6P_{\frac{1}{2}}$ level. A strong magnetic field effect on positive column emission was established. The intensity of all cesium radiation lines diminished with increased field (intensity of Cs 4555 to 4593 Å dropped 10 to 15 fold at $H \approx 1000$ gauss), while the recombined glow increased especially at low pressures. (R.V.J.)

13830 ISOTOPIC EFFECT IN THE VAPOR PHASE. I. B. Rabinovich. Uspekhi Khim., 31: 101-52(Jan. 1962). (In Russian)

The vapor pressure of isotopic compounds is given in the form of the empirical equation $\lg P = f(T)$, where P is the vapor pressure in mm Hg std and T is the absolute temperature. The ratio P_H/P_L is also given, where H refers to the heavy isotope and L refers to the light isotope. The vapor pressure is given for the following monoatomic substances: He^4-He^3, $Ne^{22}-Ne^{20}$, $Ar^{38}-Ar^{36}$, Xe mixture and $Hg^{204}-Hg^{198}$. In this case, the heavier isotope had a lower pressure than the lighter isotope, but the isotopic effect decreased with increasing temperature. Vapor pressures are given for diatomic molecules such as: H_2, HD, D_2, T_2, $C^{13}O^{16}$ and $C^{12}O^{16}$, $N^{15}O^{16}$ and $N^{14}O^{16}$, HI and DI, and Cl_2^{37} and Cl_2^{35}. In general, the vapor pressure can be expressed by the relation $\lg P_{mm} = A-B/T$, where A and B are constants. Whether a positive or negative isotopic effect is observed depends on the value of the constant A and B, and on the temperature. Vapor pressure data are presented for various deuterated methanes (CH_4, CH_3D, CH_2D_2, CHD_3 and CD_4), for the silanes SiH_4 and SiD_4, and numerous other organic compounds. Interpretation of the isotopic effect observed in the relative vapor pressure is carried out by taking into account the chemical potential and relative masses. (268 references.) (TTT).

13831 GROUND STATE OF A FERMI GAS WITH HARD-CORE INTERACTION. H. Kuemmel (Max-Planck-Institut für Chemie, Mainz). Z. Physik, 166: 243-56(1962). (In German)

The decomposition of the ground state wave function of a Fermi gas interacting via hard core potentials into cluster functions S_n leads to a systematic expansion of wave function and energy in powers of the parameters $c = p_F r_c$ (r_c = hard core radius, p_F = Fermi momentum). For instance, S_n has the order of magnitude $c^{n-\lambda-1}$, if λ = number of Fermion coordinates with distances smaller than r_c. The first three energy terms agree with the ones given by other authors. Any occurrence of singular terms in the intermediate steps of the derivation can be avoided. (auth)

13832 PRODUCTION OF A NEUTRAL HYDROGEN ATOMIC BEAM IN THE Mev RANGE. H. Spehl and H. Roepke (Universität, Freiburg i. B.). Z. Physik, 166: 311-17(1962). (In German)

An arrangement is described to produce a neutral hydrogen beam by splitting an accelerated H_2^+-ion in a gas target. At 500 kev energy of the neutral H atom, the ratio of H_2^+-ions to neutral H atoms is measured to be about 12%. In the energy domain of 300 to 650 kev this ratio decreases only very little with increasing energy. The cross sections σ_1, σ_2 and σ_3 for splitting in $H^+ + H^0$, $2H^+ + e^-$ and for electron loss of the neutral atom are given. (auth)

13833 INVESTIGATION OF THE SUPERLINEAR LUMINESCENCE YIELD OF ZnCdS PHOSPHORS IN DEPENDENCE ON THE EXCITATION INTENSITY AND THE TEMPERATURE. [PART] I. Hans Eder (Technische

Hochschule, Munich). Z. Physik, 166: 328-40(1962). (In German)

On self-activated ZnCdS phosphors, some of which contain nickel and others which do not, the luminescence yield was measured over eight orders of magnitude of the excitation intensity and in the temperature range from −120 to 23°C. The luminescent intensity varied over 12 orders of magnitude. Under extremely weak excitation (in the unit cell absorption) a constant yield range, independent of the excitation intensity was found. From this yield range a supralinear yield increase results. The supralinear yield increase was explained as a saturated phenomenon in the bond site. A good agreement was obtained between the Schon theory and the experimental results with respect to the course of the yield curves, the effect of Ni centers, and the temperature dependence. As criteria for the occurrence of the supralinearity in ZnCdS phosphors, the theoretical requirements $E_n > E_p$ and $H \ll A$ were confirmed, i.e., deep bond sites must be present in lower concentrations than for the activator. (tr-auth)

13834 IONIZATION OF INTERNAL ELECTRON SHELLS IN THE STOPPING OF FISSION PRODUCTS. Peter Armbruster (Technische Hochschule, Munich). Z. Physik, 166: 341-54(1962). (In German)

The ionization of the inner electronic shells following the stopping of fission fragments in various materials was studied. The ionization in the inner shells of the stopping material as well as of the fission fragments was detected. The measured x-ray quanta have energies from 2 kev up to 11.5 kev. The data give evidence of the ionization cross section and its dependence on the velocity of the fission fragments. The cross section varies appreciably with the ionization energy. It has a value ranging from (10^{-17} to 10^{-23}) cm^2. Formvar as stopping material shows an ionization cross section which increases with the tenth power of the relative velocity of the colliding particles. (auth)

13835 1961 RESEARCH HIGHLIGHTS OF THE NATIONAL BUREAU OF STANDARDS. ANNUAL REPORT, FISCAL YEAR, 1961. (National Bureau of Standards, Washington, D. C.). Miscellaneous Publication 242. Dec. 1961. 211p. $0.75(GPO).

A review of research on physics, electronics, and measurement standards is presented. Included is a summary of work in the fields of metrology, mechanics, electricity, radio standards, heat, atomic physics, and radiation physics. Research is also summarized on analytical and inorganic chemistry, physical chemistry, mineral products, metallurgy, and organic and fibrous materials. Work in special programs is reported in applied mathematics, data processing, instrumentation, radiopropagation, cryogenic engineering and building research. (J.R.D.)

13836 ELEMENTS OF HAMILTONIAN MECHANICS. D. Ter Haar. From the Series in Physics. Amsterdam, North Holland Publishing Company, 1961. 198p.

The fundamentals of Hamiltonian mechanics are derived from the Newtonian and Lagrangian formulations. Within the Hamiltonian framework, attention is given to small vibrations, dynamics of rigid bodies, the canonical equations, the Hamilton-Jacobi method, perturbation theory, and continuous systems. (T.F.H.)

13837 ATOMIC ENERGY LEVELS IN CRYSTALS. John L. Prather (National Bureau of Standards, Washington, D. C.). National Bureau of Standards Monograph 19. Feb. 24, 1961. 87p. $0.60(GPO).

Discrete energy levels observed within certain crystals are treated as due to perturbations of the energy levels of the free ion by an electrostatic field arising from the crystal lattice. The analytic procedures for determining the field from the charge configuration are given, and the resulting fields are classified according to their symmetry. After a general survey of group-theoretical ideas, the applicable groups are analyzed in detail, and characters appropriate for both integral and half-integral angular momenta of the free ion are tabulated. These are applied to the determination of the number and type of levels arising from a free ion level with $J \leq 8$. The results of this analysis are tabulated, as are the selection rules for electric dipole, magnetic dipole, and electric quadrupole transitions. Calculation of the perturbation matrix elements by the use of Wigner and Racah coefficients is discussed. Examples of the application of these several techniques to specific problems are given. (auth)

13838 FINE GRAIN NUCLEAR EMULSION. Albert J. Oliver (to U. S. Atomic Energy Commission). U. S. Patent 3,031,304. Apr. 24, 1962.

A method of preparing nuclear track emulsions having mean grain sizes less than 0.1 microns is described. The method comprises adding silver nitrate to potassium bromide at a rate at which there is always a constant, critical excess of silver ions. For minimum size grains, the silver ion concentration is maintained at the critical level of about pAg 2.0 to 5.0 during precipitation, pAg being defined as the negative logarithm of the silver ion concentration. It is preferred to eliminate the excess silver at the conclusion of the precipitation steps. The emulsion is processed by methods in all other respects generally similar to the methods of the prior art. (AEC)

Astrophysics and Cosmology

13839 SEMIEMPIRICAL MODEL OF THE INTERPLANETARY MEDIUM. John C. Brandt and Richard W. Michie (Univ. of California, Berkeley). Phys. Rev. Letters, 8: 195-6(Mar. 1, 1962).

A model extending from the corona to about 5 astronomical units is presented. The interplanetary plasma expansion velocity run was inferred from comet-tail orientations in the cornet-orbit plane. The density run was computed from the continuity equation appropriate for spherical geometry. A relation between the velocity space anisotropy, mean expansion velocity, temperature, density, conduction, and heliocentric distance was obtained. Calculations are presented in graphical form. (L.N.N.)

13840 IMPLICATIONS FOR COSMOLOGY OF STELLAR AND GALACTIC EVOLUTION RATES. R. H. Dicke (Princeton Univ., N. J.). Revs. Modern Phys., 34: 110-22 (Jan. 1962). (PUC-1961-40)

A study is made of estimates of stellar and galactic evolution, of stellar and galactic ages, of the age of U, and of the evolutionary age of the universe. The results of this study are compared with the predictions of several cosmologies, viz. the steady-state cosmology, the evolutionary cosmology, the Dirac cosmology, and the Brans-Dicke cosmology. The various methods used in age estimates are described. (T.F.H.)

13841 NUCLEAR CLUES TO THE EARLY HISTORY OF THE SOLAR SYSTEM. William A. Fowler (California Inst. of Tech., Pasadena). Science, 135: 1037-45(Mar. 23, 1962).

Discussion is given on the present implication of the observed abundances of D^2, Li^6, Li^7, Be^9, B^{10}, and B^{11} in terrestrial and meteoritic matter. The abundances indicate that the synthesis of these light nuclei occurred during an intermediate state in the early history of the solar system.

Synthesis occurred through spallation and neutron reactions simultaneously induced in the outer layers of the planetesimals by the bombardment of high energy charged particles, mostly protons, accelerated in magnetic flares at the surface of the condensing sun. The importance of the (n,α) reactions for Li^6 and B^{10} is indicated by the relatively low abundances of these two nuclei. Anomalous abundances of Xe^{129} and Ag^{107} observed in meteorites can be attributed to the decay of radioactive I^{129} and Pd^{107} produced in the planetesimals. The interval between the irradiation of the small planetesimals and various stages of the formation of large bodies in the solar system is found to be between 10^6 and 10^9 years. It is concluded that the isotopic compositions of hydrogen, lithium, and boron and the existence of abundance anomalies in meteorites serve as clues to a remarkable and interesting stage in the development of the solar system. (P.C.H.)

13842 PHYSICS OF THE AURORA AND AIRGLOW. Joseph W. Chamberlain. International Geophysics Series. Volume 2. New York, Academic Press, 1961. 716p.

An outline is given of the theory of emission spectra, and of the scattering of these spectral radiations in a finite atmosphere. A study is made of processes caused by magnetic fields and charged particles in the upper atmosphere. The aurora is studied, with respect to its locations and times, its attendant physical processes in the atmosphere, its radiowave spectrum, and the origins and properties of auroral particles in space. Spectroscopic and photometric studies of the aurora and of the day, twilight, and night airglows are reported. (T.F.H.)

Cosmic Radiation

13843 (AD-262399) RADIATION EFFECTS ON MANNED SPACE FLIGHTS. Technical Report No. 156. Herbert S. Appleman (Air Weather Service, Washington, D. C.). Aug. 1961. 11p.

The types of radiation hazards that are of importance in space flight are surveyed, and their origin, probability of occurrence, feasibility of shielding, and prospects for forecasting are discussed. (auth)

13844 (PAN-278/VI) ON THE ENERGY SPECTRUM OF THE NUCLEAR ACTIVE COMPONENT OF THE COSMIC RADIATION AT 200 M AND AT 3200 M ABOVE SEA LEVEL. Jerzy Loskiewicz, Jerzy Massalski, Bronislaw Niziol, and Andrzej Oleś (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Nov. 1961. 25p.

A measurement of nuclear active particles at sea level (200 m) and at mountain altitudes (3200 m) was undertaken. The apparatus consisted of ionization chamber trays and mixed lead-graphite absorbers. The spectrum found was almost exponential. The slope had a slight increasing tendency at high energies, but was without statistical significance. The exponent of the spectrum in the energy range from 10^{12} to 5×10^{13} ev was 1.6 ± 0.2 at sea level and 1.58 ± 0.09 at mountain altitudes. It had the same value as the primary spectrum exponent in the energy interval from 10^{12} to 10^{15} ev. This means that the total inelasticity coefficient is energy independent. (auth)

13845 DETERMINATION OF A PRESSURE COEFFICIENT FOR THE PHOTON COMPONENT OF COSMIC RADIATION. R. P. Bukata, F. K. Chin, and S. Standil (Univ. of Manitoba, Winnipeg). Can. J. Phys., 40: 348-51 (Mar. 1962).

A large crystal total absorption spectrometer was used to obtain a value of $(-0.62 \pm 0.05)\%$ per mb for photons above 7 Mev and $(-0.86 \pm 0.20)\%$ per mb for photons above 35 Mev. The mathematical method used is described, and an absorption model of the atmosphere is presented. (auth)

13846 A DAY-NIGHT COMPARISON OF THE COSMIC-RAY PHOTON INTENSITY NEAR SEA LEVEL. F. K. Chin, R. P. Bukata, and S. Standil (Univ. of Manitoba, Winnipeg). Can. J. Phys., 40: 380-1(Mar. 1962).

Cosmic photons were detected using a large NaI(Tl) crystal total absorption spectrometer (S. Standil, et. al., Can. J. Phys. 39, 229(1961); 40, 348(1962)). A 100-channel analyzer was used to obtain the differential spectrum of the totally absorbed photons. Data are represented in graphical and tabular forms. (L.N.N.)

13847 DIRECTIONAL PROPERTIES OF EXTENSIVE AIR SHOWER ARRAYS. A. Bhaskara Rao and P. S. Gill (Muslim Univ., Aligarh, India). Indian J. Phys., 35: 568-72(Nov. 1961).

The simple extensive air shower array proposed by K. Y. Shen and S. T. Singer (Phys. Rev., 106: 555(1957)) for which about 90% directional efficiency was claimed, is tested by C. B. A. McCusker, et al. (Phys. Rev., 116: 181 (1959)) and W. M. Layson et al. (Nucl. Inst. Meth., 6: 179 (1960)) using it in conjunction with cloud chambers and scintillation counters, respectively. It was concluded that the proposed apparatus has poor efficiency in selecting showers in preferred directions. There are significant differences between the results on this problem, and it is possible to make further improvements in the performance of the device. (auth)

13848 RADIATION HAZARD. I. A. Savenko, N. F. Pisarenko, and P. I. Shavrin. Iskusst. Sputniki Zemli, No. 9, 71-7(1961).

Analysis of data obtained by Sputnik V (August 19, 1961) at about 320 km made it possible to delineate the position of the radiation belts and to estimate the amount of radiation hazard present. Scintillation counter data show that the radiation in the belts is anisotropic and that the energy flux under a layer of matter of 2×10^{-3} g cm^{-2} is 10^{10} ev cm^{-2} sec^{-1}. The mean energy released per quantum in the scintillation counter crystal is computed at 2.0×10^5 ev and the intensity of electrons in the outer belt at 5×10^4 particles cm^{-2} sec^{-1}. The radiation dosage absorbed inside Sputnik V was determined by dividing the amount of energy liberated in the sodium iodide crystal of the scintillation counter by the weight of the crystal (36.4 g) without the need of a detailed examination of the composition and spectrum of the radiation. A dosage value of 7 mrad/24 hr was obtained; in terms of the RBE (relative biological effect) of the cosmic charged particles this amounted to 50 mrem/24 hr. This dosage is considered relatively safe for astronauts during flights along trajectories similar to that of Sputnik V when the sun is quiet. Solar flares, however, could bring about an increase in radiation. Owing to latitude and longitude effects and the specific distribution of radiation at this height, the dosage per orbit ranged from 0.35 to 0.70 mrad. (OTS)

13849 INVESTIGATION OF SOLAR X-RADIATION. S. L. Mandel'shtam, I. P. Tindo, Yu. K. Voron'ko, A. I. Shurygin, and B. N. Vasil'ev. Iskusst. Sputniki Semli, No. 10, 12-21(1961).

Measurements of x-radiation flux in the shortwave region (<10 Å) of the solar spectrum were made during vertical launchings of two geophysical rockets in the morning and evening of July 21, 1959. Photon counters were used as receivers of radiation. The sensor unit was housed on the outside of the equipment container, which detached itself from the rocket and oriented automatically toward the sun

while following the rocket trajectory during the rest of the ascent and the descent to the dense atmospheric layers. These two counters were used to record bremsstrahlung from low-energy electrons. From the counters the pulses were transmitted to earth by means of a telemetric system which made it possible to calculate the counting rates as functions of container altitude, wavelength, counter plate intensity, and irradiation density. The distribution of the number of photons in the solar spectrum was calculated for an area of 1 cm^2 and a special interval of 1 Å. It was determined that beyond the atmospheric boundary the energy in the range <8 Å was $3.6 \cdot 10^{-4}$ erg cm^{-2} sec^{-1} for the morning and $1.6 \cdot 10^{-4}$ erg cm^{-2} sec^{-1} for the evening launching. The respective figures for the range <10 Å were $7.3 \cdot 10^{-4}$ and $3.2 \cdot 10^{-4}$ erg cm^{-2} sec^{-1}. (OTS)

13850 ANISOTROPY IN SOLAR PARTICLES INCIDENT ON POLAR REGIONS DURING JULY 1961. M. A. Pomerantz and S. P. Duggal (Bartol Research Foundation of the Franklin Inst., Swarthmore, Penna.). J. Franklin Inst., 273: 242-8(Mar. 1962).

Neutron monitor data are presented for Thule, Greenland (geomagnetic latitude 88°N) and McMurdo Sound, Antarctica (geomagnetic latitude 79°S) for the two sudden cosmic ray intensity increases on July 18 and 20, 1961. Comparisons are made with other stations, and the solar flares and other cosmic ray events associated with the increases are discussed. (D.L.C.)

13851 COSMIC RAY HARD SHOWERS BELOW GROUND. Shigeru Higashi (Osaka City Univ.). J. Phys. Soc. Japan, 17: 273-9(Feb. 1962). (In English)

The hard showers observed with a large multiplate cloud chamber at 50 and 250 mwe underground were analyzed. These showers were classified according to the nature of their parents. The relative frequency of π- and μ-induced showers, r, was $r_{50} = 0.46 \pm 0.22$ and $r_{250} = 0.69 \pm 0.29$. These results agree with theoretical calculation. The energy of each μ-induced shower is obtained assuming (1) a model of collisions at a c.m.s. of the virtual photons and the nucleons, (2) one fire-ball model, and (3) the model of constant transverse momentum of secondary particles. Energy distributions obtained are compared with those of the Williams-Weizsäcker method. The value of photo-nuclear cross section is constant to several tens of Bev of shower energy. The angular distribution of the secondary π-meson is isotropic in the model of (1) or (2). (auth)

13852 NUCLEAR INTERACTIONS OF HIGH-ENERGY COSMIC RAYS OBSERVED NEAR SEA LEVEL. W. Pak and K. Greisen (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 125: 1668-70(Mar. 1, 1962).

Nuclear interactions of magnetically analyzed cosmic rays above 8 Bev are observed near sea level at two zenith angles, 0 and 68°, in an effort to obtain information on the nuon nuclear interaction cross section for events of ~200 Mev threshold energy, and on the vertical intensity of sea-level protons having ~20 Bev median energy. The muons selected are comparable in energy to those at an underground depth of ~300 meters water equivalent (m.w.e.). The result agrees with data at 310 and 590 m.w.e. All three points, however, lie above the cross sections calculated with the Williams-Weizsäcker method. In view of large statistical errors the departure cannot be taken too seriously, but it suggests an increase of photonuclear cross section with energy. The statistical error in the derived proton intensity is also large. The average elasticity of high-energy nuclear collisions consistent with the observed proton intensity is roughly 50%. The spectral point indicates a differential proton spectrum that can be represented by a power law with exponent $\gamma = 1.9 \pm 0.3$. The spectrum of primary particles that contribute to the sea-level proton flux in the 1 to 20 Bev energy range fits a power law with $\gamma \simeq 2.4$. The fact that the sea-level spectrum is harder than the primary spectrum suggests that the elasticity is an increasing function of energy. (auth)

13853 PROGRESSIVE ROTATION OF COSMIC-RAY DIURNAL VARIATION VECTOR. S. P. Duggal and M. A. Pomerantz (Franklin Inst., Swarthmore, Penna.). Phys. Rev. Letters, 8: 215-16(Mar. 1, 1962).

A progressively anticlockwise rotation of the anisotropy was directly observed for 7 days, using a large-area high-counting-rate plastic scintillator meson telescope. The nature of the modulation mechanism producing the anisotropy is discussed. Data are presented in graphical form. (L.N.N.)

13854 ATMOSPHERIC EFFECTS ON THE MESON INTENSITY RECORDED BY THE INTERNATIONAL STANDARD CUBE AT A HIGH LATITUDE STATION. S. Lindgren (Univ. of Uppsala) and F. Lindholm. Tellus, 13: 280-90 (May 1961). (In English)

Cosmic-ray and upper-air data recorded at Murchison Bay during the IGY were used to estimate the atmospheric effects on the sea level meson intensity recorded by the standard cube. The pressure corrected nucleonic intensity was used to eliminate variations due to fluctuations in the primary intensity. It is shown that the regression equations proposed by Duperier and Dorman lead to practically identical corrections for the atmospheric effects. (auth)

Criticality Studies

13855 (ANL-6462) EBR-II DRY CRITICAL EXPERIMENTS. Experimental Results. R. L. McVean, G. S. Brunson, B. C. Cerutti, W. B. Loewenstein, F. W. Thalgott, and G. K. Whitham (Argonne National Lab., Ill. and Argonne National Lab., Idaho Falls, Idaho). Feb. 1962. Contract W-31-109-Eng-38. 39p.

Preoperational zero-power nuclear investigations were carried out in the Experimental Breeder Reactor II (EBR-II) prior to insertion of sodium coolant. The experiments were performed with the power reactor instruments, fuel, and mechanical components installed. The measured dry critical size, reactivity worth of control mechanisms and isothermal temperature coefficient of reactivity are in good agreement with predicted values. Additional measurements include neutron flux distributions in the uranium reflector and outside the reactor neutron shield. (auth)

13856 (BAW-1232) EXPONENTIAL EXPERIMENTS ON LATTICES MODERATED BY D_2O-H_2O MIXTURES. Spectral Shift Control Reactor — Basic Physics Program. L. G. Barrett and J. H. Mortenson (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Jan. 1962. Contract AT(30-1)-2602. 78p.

The results of exponential experiments performed under the Spectral Shift Control Reactor (SSCR) Basic Physics Program are summarized. The material buckling and cadmium ratio of U^{235} were measured at room temperature in rod lattices moderated by D_2O-H_2O mixtures in which the non-moderator-to-moderator volume ratio was approximately 1.0. The two types of fuel studied were 93%-enriched UO_2-ThO_2 pellets ($N_{Th}/N_{25} = 15$) clad in 0.308-inch OD aluminum tubes and 4%-enriched UO_2 swaged in 0.476-inch OD stainless-steel tubes. The results are shown in the following tabulation, where the measured cadmium ratio of thorium in the first lattice is 1.14 ± 0.02. Also given is

design information on the Lynchburg Source Reactor (LSR), which was assembled and operated at 1000 watts to provide neutrons for these experiments. (auth)

13857 (HW-70310) MEASUREMENT OF MULTIPLICATION CONSTANT FOR SLIGHTLY ENRICHED HOMOGENEOUS UO_3–WATER MIXTURES AND MINIMUM ENRICHMENT FOR CRITICALITY. V. I. Neeley and H. E. Handler (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 21, 1961. Contract AT (45-1)-1350. 77p.

The minimum U^{235} enrichment required for criticality in an infinite homogeneous system of uranium trioxide (UO_3) and water has been determined from measurements of k_∞ in the Hanford Physical Constants Testing Reactor, (PCTR) This is the enrichment for which $k_\infty \leq$ unity in an aqueous homogeneous system. The experiments consisted of k_∞ measurements at U enrichments of 1.006, 1.070, and 1.159 weight per cent U^{235} for H-to-U atomic ratios in the range of 3.5–7.5. The minimum enrichment required for criticality in an infinitely large system with a homogeneous UO_3-water mixture was found to be $1.034^{+0.010}_{-0.009}$ wt % U^{235}. (auth)

13858 (NAA-SR-Memo-6505) MEASUREMENT OF THE WORTH OF A CRUCIFORM POISON ROD IN THE OMR CRITICAL ASSEMBLY. H. C. Field (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 9, 1961. Contract [AT(11-1)-Gen-8]. 17p.

The worth of a 3.382-in.-span Cd-Ag cruciform rod operating in a control-rod hole in the OMR Critical Assembly was found to be (90.5 ± 0.4)¢, or 0.64 times that of a standard $4\frac{1}{2}$-in.-OD cylindrical rod, in good agreement with the rubber-band model. Moving the cruciform rod to an adjacent location between fuel elements and plugging the control-rod hole with a fuel element increase its worth to 201¢. Worth measurements on other control-rod sizes and shapes are summarized in tabular form. (auth)

13859 HEAVY WATER EXPONENTIAL EXPERIMENTS USING ThO_2 AND UO_2. J. A. Thie. International Series of Monographs on Nuclear Energy. Division X. Reactor Design Physics. Volume 5. New York, Pergamon Press, 1961. 179p. $6.00.

A survey is given of facilities, experimental data, and theoretical interpretations of D_2O-moderated exponential experiments utilizing UO_2 or ThO_2–UO_2 mixtures as fuel. (T.F.H.)

Elementary Particles and Radiations

13860 (AD-261696) DOSIMETRY OF PROTON RADIATION IN SPACE. Report No. 19. Hermann J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.). June 6, 1961. 25p.

The energy spectra of the proton radiation in the inner Van Allen belt, and of the proton flux after large solar flares, are selected as examples for an analysis of the intratarget distribution of the RBE dose in rem. It is shown that greatly different depth doses ranging from 0.6 per cent to 64 per cent of the surface dose are obtained depending on types of spectrum and shielding thicknesses. Because of this extreme variation in the depth dose pattern, a concise and general determination of the total body radiation burden seems impossible. The situation is mitigated by the fact that, because of the comparatively small share of low energy particles in the local spectrum, the mean RBE never exceeds 1.5. This value distinguishes proton beams in space from neutron-produced recoil protons of reactors which are exclusively low energy and have a mean RBE of 10.0. (auth)

13861 (JINR-D-844) EXPERIMENTAL EVALUATION OF THE $\pi^+ \rightarrow \pi^0 + e^+ + \nu$ DECAY PROBABILITY. A. F. Dunaitsev, V. I. Petrukhin, Yu. D. Prokoshkin, and V. I. Rykalin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 10p.

By means of γ-γ coincidences it is shown that the probability of positive pion β decay does not exceed 7×10^{-8} of the probability of muon decay of pion. For the constant G that determines the intensity of this process in the case of vector current conservation, it is found that $G < 2.5\ G_\beta$, where G_β is the constant of the weak vector β interaction. (auth)

13862 (JINR-D-900) ON THE ASYMPTOTIC BEHAVIOUR OF THE ELASTIC $\pi\pi$ AND πN SCATTERING AMPLITUDE. G. Domokos (Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 4p.

A more accurate approach is offered to the problem of the asymptotic behavior of the elastic scattering amplitude of π-π and π-N interactions. Equations are given for partial wave amplitude analysis. (M.C.G.)

13863 (JINR-P-863) IZMERENIE KOEFFITSIENTA SPINOVOI KORRELYATSII C_{kp} DLYA (p-p)-RASSEYANIYA PRI ENERGII 660 MEV. (Measurements of the Spin Correlation C_{kp} Coefficient in (p-p) Scattering at 660 Mev). V. I. Nikanorov, G. Peter, A. F. Pisarev, and Kh. Poze (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 8p.

The spin correlation coefficient C_{kp} in elastic proton-proton scattering was measured for an energy of 660 Mev at an angle of 90° in the c.m.s. C_{kp} (90°) was found to be 0.22 ± 0.18. (auth)

13864 (JINR-P-888) OB ASIMPTOTICHESKOM POVEDENII VERSHINNOI CHASTI V PSEVDOSKALYARNOI MEZONNOI TEORII. (On the Asymptotic Behavior of the Apex Section in Pseudoscalar Meson Theory). G. Domokosh (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 6p.

The asymptotic behavior of the vertex part is investigated under the assumption that $Z_2 < \infty$, $Z_3 < \infty$. The mesic form factor of the nucleon behaves as $(\log q^2)^{-\gamma_3}$, for $q^2 \rightarrow \infty$. (auth)

13865 (NEVIS-101) MAGNETIC MOMENT OF NEGATIVE MUONS (thesis). J. Menes (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.). Feb. 1962. Contract Nonr-266(72). 28p.

The magnetic moment of negative muons bound in atoms of carbon, oxygen (in water), magnesium, silicon, and sulfur is measured with a precision ranging from 3×10^{-3} in carbon to 1.6×10^{-4} in sulfur. The measured moment is corrected for relativistic effects, diamagnetism, nuclear polarization, and (in the case of carbon and magnesium) Knight shift, before being compared to the moment of the positive muon. The two moments are found to be equal to 3 parts in 10^4, where the major uncertainty is caused by the Knight shift. The relativistic, diamagnetic, nuclear, and solid state shifts are large enough compared to the statistical and systematic errors to make this technique usable for the investigation of these effects. (auth)

13866 (NP-11421) ON BARYON ANOMALOUS MAGNETIC MOMENT CONTRIBUTION TO NEUTRAL PI MESON DECAY. Prem Prakash (Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas). Nov. 27, 1961. 16p. (Notas de Física, Vol. VIII, No. 18 p.325-39).

The disintegration rate of the π^0 meson into two photons is calculated in a model in which the decay takes place via virtual baryon–antibaryon pair, taking into account the effect of the anomalous magnetic moments of these baryons. The lifetime is found to depend appreciably on nucleon and Ξ hyperon virtual pair contributions, but not so much on Σ hyperon pair contributions, if the mirror theorem for the magnetic moments of Σ is assumed. The branching ratio $\pi^0 \to e^+ + e^- + \gamma/\pi^0 \to \gamma + \gamma$ is not appreciably affected by inclusion of the anomalous baryon magnetic moments. (auth)

13867 (NYO-10033) RESONANT STATISTICAL MODEL OF PARTICLE PRODUCTION. G. Pinski (Rochester, N. Y. Univ.). Jan. 22, 1962. Contract AT(30-1)-875. 24p.

The statistical model modified to include resonant interaction is discussed. It is shown that arbitrary mass-squared distributions calculated from Lorentz invariant phase space can be expressed as a product of two phase space factors. Expressions arising in the modified model were reduced to either products of phase space factors or simple integrals over such products. Application to nucleon-antinucleon annihilation into pions is given. Results are presented for the reaction $p + \bar{p} \to 2\pi^+ + 2\pi^- + \pi^0$ at antiproton momentum 1.61 Gev/c, and the observed three-pion mass distributions were fitted with a half-width for the ω resonance of 10.1 ± 2.9 Mev. (auth)

13868 (NYO-10037) INVARIANT ANGULAR FUNCTIONS FOR A PRODUCTION REACTION INVOLVING SPINLESS PARTICLES. A. J. Macfarlane (Rochester, N. Y. Univ.). Feb. 6, 1962. Contract AT(30-1)-875. 24p.

In the partial wave analysis, either non-relativistic or relativistic, of a reaction with two incoming and three outgoing particles, all spinless, and in the theory of triple angular correlations, a certain class of invariant functions involving three spherical harmonics occur. In each case, an explicit statement of the dependence of the functions on the angles between the three vector arguments of the harmonics was sought. Methods for obtaining this dependence were developed. A tabulation of results for the invariant functions of low order was made. (auth)

13869 (NYO-10125) SOME CONSIDERATIONS ON ELEMENTARY PARTICLES AND BOUND STATES IN STRONG INTERACTIONS. R. Acharya (Rochester, N. Y. Univ.). Feb. 16, 1962. Contract AT(30-1)-875. 9p.

The conjecture that the $\not{Z} = 0$ limit of an "elementary particle" theory (where $\not{Z}$ is the wave function renormalization constant) yields a theory in which the particle could be regarded as "composite" was examined from field-theoretical considerations. The eigenvalue equation used in dispersion theory relating the coupling constant to the masses was derived. (auth)

13870 (NYO-10127) EFFECT OF THE π-π AND K-π RESONANCES ON THE KAON FORM FACTOR. Samir K. Bose (Rochester, N. Y. Univ.). Feb. 20, 1962. Contract AT(30-1)-875. 10p.

The iso-vector part of the kaon form factor was studied in the two pion approximation. For the $\pi + \pi \to K + \bar{K}$ amplitude, a Mandelstam representation was assumed. The effect of the π-π resonance was straightforward. The effect of the K-π resonance showed up in the left-hand out of the $\pi + \pi \to K + \bar{K}$ amplitude. (auth)

13871 (UCRL-9841) PHOTOPRODUCTION OF π^+ IN HYDROGEN (thesis). Donald A. McPherson (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 19, 1961. Contract W-7405-eng-48. 85p.

Differential cross sections for photopion production from protons were measured for 32 photon energies from 154 to 185 Mev with the 4-in. liquid-hydrogen bubble chamber and the Berkeley electron synchrotron. High photon intensities of 1.5×10^7 Mev/pulse were used by collimating the beam down to a narrow "ribbon" which was viewed on edge by the camera. Although the pion origins were obscured by the heavy electron background, the remainder of the pion track was visible for most events. Of 5000 $\pi-\mu$ decays seen, 3400 were deemed suitable for calculations. The results are in excellent agreement with the theoretical calculations of Ball who applied the Mandelstam representation to the process. The combined measured cross sections, averaged over the pion c.m. angles, for photon energies of 154, 157, 162, 167, 172, 177, and 182 Mev are 2.71 ± 0.78, 3.48 ± 0.12, 4.62 ± 0.14, 6.07 ± 0.22, 6.47 ± 0.31, 5.74 ± 0.43, and 6.37 ± 0.71 μb/Mev-sterad respectively. All data are subject to an additional correlated error of 4.1% because of the uncertainty in the beam normalization. Also a value of $A = (-0.397 \pm 0.552)e$ was obtained, where A is the multiplicative factor associated with the matrix element for photopion production from pions as calculated by Wong. (auth)

13872 (UCRL-9999) BIBLIOGRAPHY ON PION-PION INTERACTION. M. Lynn Stevenson (California. Univ., Berkeley. Lawrence Radiation Lab.). Nov. 7, 1961. Contract W-7405-Eng-48. 63p.

A bibliography on pion-pion interactions is presented. The 241 references are those available through November 7, 1961. A chronological listing is given together with excerpts or comments. In another part the references are grouped according to subject. An author index is included. (M.C.G.)

13873 (FTD-TT-61-448) ČERENKOV RADIATION EMITTED BY MAGNETIC AND ELECTRIC DIPOLES. A. B. Kukanov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 2, 28-33(1961). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 31515.

13874 (UCRL-Trans-78) TABLES OF PHASE VOLUMES. G. I. Kopylov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). Translated by Sergey Shewchuck (Univ. California Lawrence Radiation Lab., Berkeley) from Report JINR-P-777. 1961. 47p. (Includes original, 35p.).

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 5924.

13875 MEASUREMENT OF THE CIRCULAR POLARIZATION OF HIGH-ENERGY COLLIMATED γ-RAY BEAMS. E. Lerner, G. Moscati, E. Silva, and J. Goldemberg (Universidade, São Paulo, Brazil). Anais acad. brasil. cienc., 33: 281-8(1961). (In English)

The measurement of circular polarization at energies higher than 5 Mev using the forward Compton scattering of γ rays is discussed. Attempts were made to measure the circular polarization of bremsstrahlung radiation produced by electrons accelerated in a Betatron to an energy of 22 Mev. The x rays were collimated to a $\frac{1}{4}$ in. beam and then traversed a $\frac{1}{4}$ in. plate of a permanent Alnico. The Compton scattered fraction of the beam was allowed to hit a 2 in. internal diameter copper cylinder centered with respect to the incident beam. The experimental value obtained was δ (experimental) = 0.014 + 0.024. No circular polarization of the bremsstrahlung beam was detected. Therefore, it was concluded that the degree of circular polarization of the beam $P < 30\%$. (P.C.H.)

13876 THE STRONG COUPLINGS IN A SPACE WITH TORSION. R. Finkelstein and W. Ramsay (Univ. of California, Los Angeles). Ann. Phys. (N. Y.), 17: 379-403 (Mar. 1962).

A generally covariant field theory, characterized by an asymmetric metric, an asymmetric connection, and an arbitrary gauge group is investigated as a possible formal basis for the experimentally observed strong couplings. Transposition invariance is put into correspondence with TCP invariance. The parts of the connection irreducible under both coordinate and gauge groups are identified with the independent boson fields. Representations of the strong and electromagnetic couplings of the baryon-meson system are found, subject to the same dynamical uncertainties as global and unitary symmetry. In the simplest version, the pion and kaon fields correspond to the Hermitian torsion, while the vector bosons, including the photon, correspond to the anti-Hermitian torsion. (auth)

13877 A DEMONSTRATION OF THE BACKSCATTERING OF ELECTRONS FROM TARGETS OF DIFFERENT ATOMIC NUMBER. B. W. Schumacher (Ontario Research Foundation, Toronto). Can. J. Phys., 40: 376(Mar. 1962).

An electron beam at 45 kev and 60 μa is directed against targets of C, Al, Pb, and glass located in spaces at low pressures. Due to gaseous fluorescence, the beams are visible; the gas scattering is small. Photographs are presented. (L.N.N.)

13878 A POSSIBLE TEST OF QUANTUM ELECTRODYNAMICS BY MEANS OF POLARIZATION EFFECTS IN ELECTRON-NUCLEON SCATTERING. J. Tolar (Technical Univ., Prague). Czechoslov. J. Phys., B 11: 799-807(1961). (In English)

The differential cross-section is given for electromagnetic scattering of polarized relativistic electrons on polarized nucleons. The finite size of each particle is considered by means of two form-factors. The effect of the possible non-punctiform structure of the electron on the polarization effects in scattering is discussed. It is shown that the internal structure of the anomalous magnetic moment of the electron would be manifested in the cross-section by terms depending on the transversal polarization of the incident electrons. (auth)

13879 POSITRONIUM. F. F. Heymann. Endeavour, 20: 225-31(Oct. 1961).

A review is given of the properties of positronium. The production, decay, detection, gamma spectra, and lifetimes of singlet and triplet positronium are discussed. The quenching of triplet to singlet positronium, and the possibility of an optical spectrum for triplet positronium, are outlined. (T.F.H.)

13880 CROSS SECTIONS FOR ELEMENTARY PARTICLE INTERACTIONS. V. S. Barashenkov and V. M. Maltsev (Joint Inst. for Nuclear Research, Dubna, USSR). Fortschr. Physik, 9: 549-611(1961). (In English)

Cross section data for interactions of nucleons, antinucleons, mesons (K), and mesons (π) are compiled and discussed. At high energies, specific features common to particles of different kinds exist. Information on phenomena occurring in the region of very small space-time scales may be obtained. Most of the data is obtained from experiments using accelerators in which large particle-beam densities facilitate precision measurements. Weak neutrino reactions at high energies are discussed. (L.N.N.)

13881 ELEMENTARY EXCITATION SPECTRUM IN A SYSTEM OF INTERACTING MAGNETIZED FERMI PARTICLES. L. Ya. Kobelev (Gorkii Ural State Univ., USSR). Izvest. Vysshikh Ucheb. Zavedenií, Fiz., No. 5, 125-33 (1961). (In Russian)

The behavior of magnetic Fermi particles ($S = h/4\pi$), described by Schwinger's equations for a single-term Green's temperature functions and with approximate mass operators determined by Fermi particles interacting through a Bose-field, indicates four types of elementary excitations. Expressions are developed for elementary excitation energies suitable for systems with incomplete magnetic saturation at $T = 0$. Excitation in high-magnetization systems, where the excitations differ in exchange energy and three types of spin oscillation energy exist, is analyzed. It is shown that the spin wave spectrum includes terms proportional to the magnetization density components σ_z, σ_x, and σ_y, depending on the type of spin waves. (R.V.J.)

13882 GENERALIZATION OF ASYMPTOTIC SELF-CONSISTENCY METHOD. V. D. Kamenetskii (All-Union Correspondence Inst. of Textiles and Light Industry, USSR). Izvest. Vysshikh Ucheb. Zavedenií, Fiz., No. 5, 134-41(1961). (In Russian)

A generalization of the asymptotic self-consistency method is suggested for calculating problems in quantum mechanics and for testing the accuracy of trial function parameters. The method is applied for resolving problems in the continuous spectra of electron scattering and triple neutron scattering on protons and for calculating the wave functions and energy level problems in the discrete spectra of H, D, He, and dielectron ions. The numerical calculations of scattering amplitudes, wave functions, and energy levels exhibited high accuracy and precision. (R.V.J.)

13883 SINGLE-PARTICLE EXCITATIONS AND SUPERFLUIDITY IN FERMI SYSTEMS WITH ARBITRARY INTERACTION. APPLICATION TO THE NUCLEUS. A. B. Migdal (Physical-Engineering Inst., Moscow). Nuclear Phys., 30: 239-57(Feb. 1962). (In English)

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 18858.

13884 $\pi-\pi$-ANOMALIES IN A SPECTRUM OF H^3 NUCLEI IN THE REACTION $p + d \rightarrow H^3 + \pi^+ + \pi^0$ WITH 670 Mev PROTONS. Yu. K. Akimov, V. I. Komarov, K. S. Marish, O. V. Savchenko, and L. M. Soroko (Joint Inst. for Nuclear Research, Dubna, USSR). Nuclear Phys., 30: 258-68(Feb. 1962). (In English)

Measurement is made of the low-energy part of the momentum spectrum of H^3 nuclei, emitted at 5.8° in the laboratory system of coordinates, in p-d collisions, for protons at 670 Mev. No evidence was obtained confirming the resonance interaction of two π mesons with isobaric spin $T_{\pi\pi} = 1$ and total energy in their center-of-mass system from 275 to 420 Mev. It was found that the cross section of the production of two π mesons in a state with $T_{\pi\pi} = 0$ exceeds by an order of magnitude that of two mesons with $T_{\pi\pi} = 1$, for a total energy in their center-of-mass system up to 400 Mev. (auth)

13885 THE POLARIZATION OF $T(p,n)He^3$ NEUTRONS FOR PROTON ENERGIES FROM 2.9 TO 12 Mev. R. L. Walter, W. Benenson, P. S. Dubbeldam, and T. H. May (Univ. of Wisconsin, Madison). Nuclear Phys., 30: 292-9(Feb. 1962). (In English)

The polarization of neutrons produced in the $T(p,n)He^3$ reaction at 2.9 to 12 Mev was measured. Polarizations were determined by scattering from helium in a high-pressure cell. By recording the helium recoils in coincidence with the scattered neutrons, background counts were reduced. A magnetic field produced by a solenoid

was used to rotate the polarization vector of the neutrons. The polarization near 45° in the center-of-mass system decreases from 0.26 ± 0.03 at 2.9 Mev to −0.20 ± 0.04 at 12 Mev, passing through zero at about 4.8 Mev. The angular distribution of the polarization changes as the proton energy increases from 2.9 to 6 Mev. However, the shape of the 12-Mev distribution is similar to that at 6 Mev. (auth)

13886 UNIFIED INTERACTIONS IN THE UNITARY GAUGE THEORY. Y. Ne'eman (Imperial Coll., London). Nuclear Phys., 30: 347-9(Feb. 1962). (In English)

Postulation of finite vacuum expectation values for K_1^0 and ρ_0 generates strong, weak, and electromagnetic interactions, and produces mass differences within the baryon and boson multiplets. (auth)

13887 KINEMATIC ANALYSIS OF HIGH ENERGY INTERACTIONS. N. G. Birger and Yu. A. Smorodin (Lebedev Physical Inst., Moscow). Nuclear Phys., 30: 350-2(Feb. 1962). (In English)

Possibilities of kinematic analysis for high-energy interactions and its main applications to experimental data are considered. The method is based on the conservation laws alone, without resort to model concepts. (auth)

13888 INTERACTION OF RADIATION AND MATTER, AND A PART OF THE NUCLEAR ENGINEERING CURRICULUM. T. Kammash and H. J. Gomberg (Univ. of Michigan, Ann Arbor). Nuclear Sci. and Eng., 12: 68-70 (Jan. 1962).

A topic outline of the one-year course on interaction of radiation and matter at the University of Michigan is presented. The contents of the course can be divided into three major subjects: the interaction of charged particles and atoms, the interaction of electromagnetic radiation (photons) and atoms, and the interaction of neutrons and nuclei. This one-year course is offered by the nuclear engineering department to all incoming students immediately upon entering the program. It forms the basis for courses in reactor theory, shielding, and radiation effects in solids. The first year graduate course also provides the necessary background for such specialized topics as thermonuclear theory where collision and radiation losses in plasma are studied in detail. (N.W.R.)

13889 SELECTED TOPICS ON ANALYTICITY IN POTENTIAL SCATTERING. A. Martin (CERN, Geneva). Nuovo cimento (10), 21: Suppl. No. 2, 157-96(1961). (In English)

Analytic properties of partial waves for Yukawa-like potentials are discussed for the S wave case, for higher angular momenta, and for the case in which tensor forces are present. Partial wave properties for generalized Yukawa potentials are applied to numerical calculations, the deuteron wave function and the anomalous threshold problem, and the connection between the unphysical cut of a partial wave amplitude, the S matrix, and the potential. Analytic properties for fixed energy are discussed. (L.N.N.)

13890 EXTRAPOLATION TO CUTS AND THE SCATTERING OF ELECTRONS AND POSITRONS. S. D. Drell and R. H. Pratt (Stanford Univ., Calif.). Phys. Rev., 125: 1394-9(Feb. 15, 1962).

The low momentum transfer region of strong-interaction processes may be discussed in terms of one-pion-exchange graphs. This success of "extrapolation to poles" suggests, as an extension, "extrapolation to cuts" corresponding to low-mass intermediate states containing two or more particles. It is found that this extrapolation may be performed in the case of electromagnetic interactions, owing to the vanishing photon mass. For small-angle scattering of relativistic electrons in a pure Coulomb field, $\sin^4(\theta/2)(d\sigma/d\Omega) = a_0 + a_1 \sin(\theta/2) + \cdots$, where a_0 is given precisely by the one-photon pole and a_1 (obtained exactly to all orders in $Z\alpha$) comes from the many-photon terms. For scattering by finite nuclei it is further found that, for fixed momentum transfer, the ratio of second to first Born approximation decreases as (energy)$^{-1}$ at high energies. This leads to a simple approximate formula for the ratio $R \equiv (\sigma_- - \sigma_+)/(\sigma_- + \sigma_+)$ of electron and positron scattering and to a simple method of determining the charge form factors of intermediate-Z nuclei. (auth)

13891 CHIRALITY CONSERVATION AND SOFT PION PRODUCTION. Y. Nambu and D. Lurié (Univ. of Chicago). Phys. Rev., 125: 1429-36(Feb. 15, 1962).

A formally γ_5-invariant system consisting of a Dirac field and a massless pseudoscalar field allows chirality conservation in the sense that its expectation value is a constant of motion. This leads to the consequence that in any reaction a change in the fermion chirality (~helicity × velocity) is compensated for by the emission of a massless boson at zero energy, which can be expressed by a simple formula relating the radiative amplitude to the elastic amplitude. Assuming the pion-nucleon system to be γ_5-invariant when the pion mass can be neglected, the formula is applied to the processes $N + \pi \to N + \pi$ and $N + 2\pi$. A reasonable agreement with experiment is obtained in a case dominated by the 3-3 resonance. (auth)

13892 PERTURBATION THEORY OF PION-PION INTERACTION. I. RENORMALIZATION. Tai Tsun Wu (Harvard Univ., Cambridge, Mass. and Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 125: 1436-50(Feb. 15, 1962).

The problem of pion-pion scattering is studied on the basis of the model of a four-particle direct interaction without derivative coupling. Renormalization is carried out for this model with a detailed analysis of overlap insertions. To every finite order in the renormalized coupling constant, it is shown that the unitarity relation holds and that the Feynman integral representation is still valid, and hence renormalization has no effect on analytic properties. (auth)

13893 PROPERTIES OF Σ DECAYS AND THE Σ^0 LIFETIME. J. Dreitlein and H. Primakoff (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 125: 1671-86 (Mar. 1, 1962).

The consequences of a possible nonconservation of parity in the electromagnetic decay, $\Sigma^0 \to \Lambda^0 + \gamma$, are deduced and an experimental test of parity conservation is proposed. In order to devise a method to determine the Σ^0 lifetime, $\tau(\Sigma^0)$ a study is made of $\Lambda^0 \to \Sigma^0$ conversion in Λ^0-nucleus collisions and it is found that the $\Lambda^0 \to \Sigma^0$ conversion induced by the nuclear Coulomb field, with cross section proportional to $Z^2/\tau(\Sigma^0)$, is the dominant process at large Z for Σ^0 generation in approximately forward directions. In addition, the implications of a principle of "minimal weak coupling" (involving a conserved baryon-meson polar-vector current) are exhibited for $\Sigma^+ \to \Lambda^0$ strangeness-conserving leptonic decays and are used to propose a further conceivable method to determine the Σ^0 lifetime. The various cross sections and decay rates are given for the two possible relative intrinsic parities of the Λ^0 and Σ^0. (auth)

13894 PRECISION MEASUREMENT OF THE u^+ LIFETIME. Richard A. Lundy (Univ. of Chicago). Phys. Rev., 125: 1686-96(Mar. 1, 1962).

A precision measurement of the mean lifetime of the positive muon, $\tau(\mu^+)$, is described. On the basis of 12 internally consistent, independent determinations performed under a variety of experimental conditions $\tau(\mu^+)$ is found to be = (2.203 ± 0.004) μsec. These determinations are performed by means of a digital electronic time interval measuring device embodying a continuous wave oscillator. The experimental conditions, in particular concerning the percentage of background events, are described. Attention is paid to sources of systematic error, such as time dependence of background events and rate dependence of the overall measuring process. All sources of background are localized, their effects quantitatively exhibited and, in general, suppressed electronically during actual lifetime determinations. The prediction of the conserved vector-current theory, using $ft(O^{14}) = (3069 \pm 13)$ sec and $m_\mu = 206.76 m_e$, is (including radiative corrections) $\tau(\mu^+) = 2.298 \pm 0.05$ μsec, and thus in disagreement with the experimental value. A discussion of the logical operation of the digital device is presented. A general formalism is given that establishes the connection between arbitrary interval distributions presented at the input of such devices and their corresponding output interval distributions. (auth)

13895 MEASUREMENT OF TOTAL CROSS SECTIONS OF K^- MESONS IN HYDROGEN AND DEUTERIUM IN THE MOMENTUM REGION 630 TO 1100 Mev/c. O. Chamberlain, K. M. Crowe, D. Keefe, L. T. Kerth, A. Lemonick, Tin Maung, and T. F. Zipf (Univ. of California, Berkeley). Phys. Rev., 125: 1696-1702(Mar. 1, 1962). (UCRL-9762).

Total cross sections of K^- mesons in hydrogen and deuterium were measured over the momentum range 630 to 1100 Mev/c. The K^--n total cross sections were obtained from deuterium and hydrogen data. A well-defined resonance appeared in the K^--p total cross section at about 1000 Mev/c. Two high-resolution velocity-selecting Cherenkov counters were used to select K^- mesons. The momentum resolution was 1 to 2%, and the momentum intervals chosen were very closely spaced. (auth)

13896 SINGLE VIRTUAL PARTICLE EXCHANGE MODEL OF HIGH-ENERGY INELASTIC GLANCING COLLISIONS. Freda Salzman and George Salzman (Univ. of Colorado, Boulder). Phys. Rev., 125: 1703-19(Mar. 1, 1962).

A general formulation, based upon field theory, is given for the single-virtual-particle exchange model of high-energy inelastic glancing or "peripheral" collisions. The main assumption of the model is that there is a region of the final-state phase space in which the cross section is dominated by single-virtual-particle exchange graphs of a particular kind. A discussion is given of the kinematics and of the region of applicability of the model. It is shown that, unlike the situation in elastic scattering, inelastic processes can occur with timelike momentum transfer, and an example in which this happens is discussed. The region in which it appears most reasonable to use the model is that characterized by final states that consist of two well-defined groups of particles. An argument based on unitarity is given, which strongly suggests that the energy dependence of this part of the peripheral nucleon-nucleon cross section is less than logarithmic at very high energies. (auth)

13897 PRODUCTION AND DECAY OF INTERMEDIATE VECTOR MESONS. J. Bernstein (Brookhaven National Lab., Upton, N. Y.) and G. Feinberg. Phys. Rev., 125: 1741-5(Mar. 1, 1962). (BNL-5737)

The decay of the intermediate vector meson (W) of the weak interactions is discussed with emphasis on the modes $W \rightarrow 2\pi$ and $W \rightarrow K + \pi$. It is noted that if the W mass is in the neighborhood of the observed π-π resonance at $\sim 30 m_\pi^2$, then the mode $W \rightarrow 2\pi$ will dominate all others. The production of W's by π's and K's is also discussed in terms of a "peripheral collision" model. (auth)

13898 REACTION, $\pi^- + p \rightarrow e^+ + e^- + n$, AS A MEANS OF MEASURING THE ELECTROMAGNETIC FORM FACTOR OF THE CHARGED PION. D. A. Geffen (Univ. of Minnesota, Minneapolis). Phys. Rev., 125: 1745-50 (Mar. 1, 1962).

The success of the single-pion-exchange approximation in explaining the experimental results for the reaction $\pi + n \rightarrow \pi + \pi + n$ in the region of the two-pion resonance suggests that the single-pion-exchange contribution to the reaction $\pi + n \rightarrow e^+ + e^- + n$ should be dominant for center-of-mass energies of the electron-positron system in the region of this resonance. A measurement of the rate of this reaction in this region should, therefore, provide direct information about the charged-pion electromagnetic form factor in the neighborhood of the two-pion resonance. A calculation is performed of the differential cross section for the reaction $\pi^- + p \rightarrow e^+ + e^- + n$, assuming a counter experiment. Estimates indicate that counting rates of the order of ten per hour are attainable by accelerators capable of producing negative-pion beams with an average flux of 10^8 pions per second. (auth)

13899 GROUND-STATE ENERGY OF THE NUCLEON. Richard J. Drachman (Brandeis Univ., Waltham, Mass.). Phys. Rev., 125: 1758-60(Mar. 1, 1962).

The method of moments is applied to the intermediate-coupling reduced Hamiltonian, whose lowest eigenvalue is a variational upper bound to the ground-state energy of the nucleon in the fixed-source model of meson theory. A discussion of the relationship between these results and a Tamm-Dancoff approximation for the reduced Hamiltonian is included. (auth)

13900 ISOBAR MECHANISM FOR PION-BARYON HIGHER RESONANCES. San Fu Tuan (Brown Univ., Providence). Phys. Rev., 125: 1761-4(Mar. 1, 1962).

Peierls isobar mechanism is extended to pion-hyperon interactions on the assumption that Y_1^* is the $\pi\Lambda$ isobar whose mass lies below the $\overline{K}N$ threshold and of spin-parity $P_{3/2}$. It is shown that this mechanism, when combined with experimental data, suggests that a pion-hyperon resonance in the I = 1 channel at c.m. energy 1645 Mev with spin-parity assignment $D_{3/2}$ is possible. This resonance state is expected to reflect in the total $K^- - p$ and $K^- - n$ (pure I = 1) cross sections as resonance peaks centered at around 685-Mev/c K meson lab momentum. Experimental implications of this isobar model for pion-baryon interactions as well as certain mathematical difficulties associated with the over-all validity of such a mechanism are also discussed. (auth)

13901 SCATTERING OF PHOTONS BY PROTONS. Lloyd G. Hyman (Harvard Univ., Cambridge, Mass.). Phys. Rev., 125: 1765-7(Mar. 1, 1962).

A model to account for photon scattering from protons in the 50 to 300 Mev range is presented. The scattering amplitude is composed of a Klein-Nishina amplitude, a resonance magnetic dipole term, a resonance electric dipole term, and a low term. Using the measured value of the π^0 lifetime = $(2 \pm 1) \times 10^{-16}$, which enters as a parameter in the Low term, the model is compared to experiment. The agreement is poor, particularly at the scattering angle = $3\pi/4$. (auth)

13902 ACNODES FOR PION-NUCLEON SCATTERING. Francis R. Halpern (Univ. of California, San Diego, La Jolla). Phys. Rev., 125: 1768-9(Mar. 1, 1962).

An implicit expression is found for the occurrence of

acnodes on the Landau curves of a certain fifth-order Feynmann diagram. These acnodes are investigated in cases in which the lines of the graph are either pions or nucleons, and in these cases are shown to give no singularities on the physical sheet. To find the Landau curves, the internal momentum vectors of the diagram are parameterized. (auth)

13903 DETERMINATION OF THE COUPLING STRENGTH OF 0 MESONS AND NUCLEONS. P. Burt and W. K. R. Watson (California Inst. of Tech., Pasadena). Phys. Rev., 125: 1770-1(Mar. 1, 1962).

Consideration of pion-nucleon elastic scattering in the forward direction at high energies indicates a possible method of determining the coupling strength of the I = 1, J = 1 two-pion resonance (ρ meson) with nucleons for zero momentum transfer. As a specific example, the case of π^--p elastic scattering is considered, and it is shown that $g^2_{\rho NN}/4\pi\hbar c \sim 0.2$. (auth)

13904 PION PRODUCTION IN THE LOW-ENERGY LIMIT. Y. S. Kim (Princeton Univ., N. J.). Phys. Rev., 125: 1771-7(Mar. 1, 1962).

The low-energy production reaction $\pi + N \rightarrow \pi + \pi + N$ is discussed in the framework of a simplified kinematics. The discussion is based on a given representation for processes with a three-particle final state. Under the assumption that the pion-pion rescattering term is dominant, branching ratios are derived for various processes. Under the same assumption, a quantitative analysis is given for the effect of the final-state pion-pion interaction on the three-particle distribution functions. (auth)

13905 ELECTROMAGNETIC TRANSITIONS BETWEEN VECTOR MESONS. J. C. Taylor (Cambridge Univ., Eng.). Phys. Rev. Letters, 8: 219-20(Mar. 1, 1962).

Evidence relative to resolution of the ρ resonance into two peaks is presented. The higher peak, ρ_2, may be close to the ω and have a half width of less than 10 Mev. The $\rho_2^0-\omega$ transition effect may be very marked. Electromagnetic interactions are introduced, and effects are discussed. (L.N.N.)

13906 IMPLICATIONS OF THE EXISTENCE OF $\Delta Q = -\Delta S$ DECAYS. R. E. Behrends (Yeshiva Univ., New York) and A. Sirlin. Phys. Rev. Letters, 8: 221-3(Mar. 1, 1962).

Theoretical and experimental implications of the existence of $\Delta Q = -\Delta S$ modes of K^0_{e3} decay are discussed with regards to weak-interaction structure. Consequences on proposed symmetry models of strong interactions are discussed. (L.N.N.)

13907 SIGN OF THE K_1-K_2 MASS DIFFERENCE. R. H. Good and E. Pauli (Centre D'Etudes Nucléaires de Saclay, France). Phys. Rev. Letters, 8: 223-5(Mar. 1, 1962).

An experimental method using the transmission-regeneration phenomenon is presented. Mesons (K_2) are passed successively through two plates of different materials, appropriately spaced, then the transmission-regenerated K_1 may be shown to be roughly proportional to $1 + \Delta\phi$, where the sign depends on the sign of the mass difference and where $\tan \phi_a = [\ln (f_+^0 - f_-^0)/\mathrm{Re}(f_+^0 - f_-^0)]$ plate a', $\Delta\phi = \phi_b - \phi_a$; f_+^0 and f_-^0 being the K^0 and $\bar{K}^0$ nuclear forward-scattering amplitude. Results are presented in tabular form. (L.N.N.)

13908 INTRINSIC STRUCTURE AND LOW-ENERGY $\pi\pi$ SCATTERING IN $K^+ \rightarrow 3\pi$ DECAY. G. Barton and C. Kacser (Clarendon Lab., Oxford). Phys. Rev. Letters, 8: 226-8(Mar. 1, 1962).

It is argued that the existence of intrinsic structure is plausible even without reference to the resonances, for a (current) × (current) model of the weak interactions would embody terms similar to the type $(\pi\, \delta_\mu K) \times (\pi\, \delta_\mu \pi)$, with derivatives in the weak Lagrangian density. It becomes implausible that the once-subtracted dispersion representation converges. For the iterative solution with scattering-length parametrization, at least two solutions are necessary; the magnitude and the slope (at a selected point) of the amplitude must be taken from observation. (L.N.N.)

13909 OBSERVATION OF PRODUCTION OF A $\Xi^- + \bar{\Xi}^+$ PAIR. H. N. Brown, B. B. Culwick, W. B. Fowler, et al. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 8: 255-7(Mar. 15, 1962).

The reaction $\bar{p} + p \rightarrow \Xi^- + \bar{\Xi}^+$ was observed in a 20-in. liquid-hydrogen bubble chamber exposed to a separated antiproton beam at 3.3 Bev/c produced in a tungsten target in the Brookhaven alternating-gradient synchrotron. Both cascade hyperons decayed in the visible region of the chamber, as did the $\bar{\Lambda}$ from the $\bar{\Xi}^+$ decay. A photograph of the event and parameter data and angles between tracks, in graphical form, are presented. (L.N.N.)

13910 EXAMPLE OF ANTICASCADE ($\bar{\Xi}^+$) PARTICLE PRODUCTION IN $\bar{p}$-p INTERACTIONS AT 3.0 Gev/c. Phys. Rev. Letters, 8: 257-60(Mar. 15, 1962).

Proton-antiproton interactions at 3.0 Bev/c were observed in the Saclay 81-cm hydrogen bubble chamber. Production of the $\bar{\Xi}^+$ occurred; a photograph of the event is presented. It is indicated that the reaction $\bar{p} + p \rightarrow \bar{\Xi}^+ + \Xi^-$ occurred. Momentum, ionization, and angle data are presented in tabular form, and a plot of the mean gap length data is given. Decays of the hyperons are discussed. (L.N.N.)

13911 DECAY RATES OF NEUTRAL MESONS. M. Gell-Mann, D. Sharp, and W. G. Wagner (California Inst. of Tech., Pasadena). Phys. Rev. Letters, 8: 261-2 (Mar. 15, 1962).

The partial width for the decay mode $\omega^0 \rightarrow \pi^+ + \pi^- + \pi^0$ can be estimated by assuming, in the sense of dispersion theory, that the process is dominated by the decay $\omega^0 \rightarrow \rho + \pi \rightarrow 2\pi + \pi$; ρ is treated as a nearly stable particle. A coupling parameter $f_{\omega\rho\pi}$ is defined, and a relation for the width is obtained. Meson ($K^0_{\pi 2}$) decay is discussed. (L.N.N.)

13912 FACTORIZATION OF COUPLING TO REGGE POLES. Murray Gell-Mann (California Inst. of Tech., Pasadena). Phys. Rev. Letters, 8: 263-4(Mar. 15, 1962).

Application of the Regge-pole hypothesis to relativistic two-body interactions is discussed. Position of the pole in the complex angular plane and coupling strength of the Regge trajectory to the particles involved are considered. Position is a characteristic of the reaction quantum numbers, but coupling strength may vary despite constant values of quantum numbers. It is argued that the factorization is valid all along the Regge trajectory. An example involving the Schrödinger equation is given. The Regge pole formalism, which rests entirely on conjecture for the relativistic problem, may require modifications for systems with important anomalous thresholds. (L.N.N.)

13913 ON THE CLASSIFICATION OF LEPTONS. P. Renson (Université, Liège). Physica, 27: 1239-44 (Dec. 1961). (In English)

Formulas giving the electric charge and the neutrinonic charge in terms of T_3 and S are generalized to apply them to leptons. There remains an unknown parameter. For a particular value of this parameter, these formulas assume symmetric forms. Values for S, T, and T_3 are assigned to

the different leptons. In addition to the known leptons (neutrino, electron, and muon) there remained a vacancy for an undiscovered lepton, which, with regard to the charges, is similar to the neutrino. This is no longer considered as a difficulty but as a prediction of the theory since the existence of two neutral leptons instead of one, the neutrino, is admitted. (auth)

13914 THE S-MATRIX FOR SYSTEMS WITH BOUND STATES. T. W. Ruijgrok (Rijksuniversiteit, Utrecht). Physica, 28: 198-205(Feb. 1962). (In English)

A unitary S-matrix is defined for a system of three particles, two of which can form a bound state. It is shown how for elastic scattering the polarization of the bound state must be taken into account. (auth)

13915 ON THE RELATIVISTIC MOTION OF TWO CHARGED PARTICLES IN CLASSICAL ELECTRODYNAMICS. Boris Leaf (Kansas State Univ., Manhattan). Physica, 28: 206-16(Feb. 1962). (In English)

The relativistic, classical motion of a pair of charged particles interacting through their electromagnetic field is described by the equation of evolution for the density distribution function in the phase space of the particles. This equation is obtained (to second order in the charges) by the method of perturbation treatment of the Liouville equation for the system of particles plus field. There is no Hamiltonian for the pair of particles. The pair distribution function is, however, a constant of the motion and its equation of motion is a Liouville equation with a Hermitian Liouville operator. A one-particle Hamiltonian may be written for each particle when the motion of the other is prescribed. According to this description, each particle moves in an electromagnetic field whose potentials are the Coulomb gauge potentials produced by the other particle moving as a source with constant velocity. (auth)

13916 MULTIPLET PRODUCTION BY X-RAYS. R. R. Roy, C. H. Blanchard, E. H. Webb, H. S. Sandhu, and R. C. Mohanty (Pennsylvania State Univ., University Park). Proc. Phys. Soc. (London), 78: 1301-3(Dec. 15, 1961).

Ilford G5, 400μ thick, nuclear emulsion plates were bombarded by a hardened x-ray beam at 5 to 90 Mev. Altogether 54433 fields of view were examined, the volume of each field of view being $120\mu \times 150\mu \times 220\mu$. A total of 21887 pairs, 1935 triplets, 106 quartets, 10 quintets and one sextet were observed. Frequency of occurrence of multiplets, (quartets, quintet, and sextet), together with the energy distribution of the small energy partners of the multiplets are presented. Possible explanations of the origin of miltiplets are discussed. (auth)

13917 OBSERVATIONS ON NARROW SHOWERS OF MESONS BELOW GROUND. H. W. Hunter and P. T. Trent (Univ. of London). Proc. Phys. Soc. (London), 79: 487-93 (Mar. 1, 1962).

The decoherence curve of meson showers underground was studied at depths of 37 and 61 meters water equivalent below sea level at separations from 0.4 to 10 m, sufficient to overlap earlier measurements at 61 mwe depth which extended to 320 m. The events recorded may be satisfactorily apportioned between events produced locally by energetic mesons, and the penetrating component of extensive air showers. The measurements are consistent with the interpretation that the multiple penetrating particles observed in cloud chambers underground represent the high particle density region of extensive showers of μ mesons. The cross section for the production of penetrating showers by μ mesons at 61 mwe depth is $(4 \pm 2) \times 10^{-31}$ cm^2 nucleon^{-1}, for an energy transfer of 8 Bev, in agreement with earlier measurements. (auth)

13918 MODELING AND CALCULATION OF TRAJECTORIES OF RELATIVISTIC CHARGED PARTICLES IN ELECTROSTATIC FIELDS. A. M. Strashkevich. Radiotekh. i Elektron., 6: 1401-2(Aug. 1961). (In Russian)

The method of gravitational models was applied in a relativistic case in which the contour is prepared not according to the potential ϕ (nonrelativistic case) but according to the effective potential ϕ^*, with ϕ^* expressed as $\phi^* = \phi - (1/2)(e\phi^2/m_0c^2)$ (where e is the algebraic charge value, $c = 3 \times 10^{10}$ cm/sec, m_0 is the rest mass). (R.V.J.)

13919 SIMPLE GROUPS AND STRONG INTERACTION SYMMETRIES. R. E. Behrends, J. Dreitlein, C. Fronsdal, and W. Lee (Univ. of Pennsylvania, Philadelphia). Revs. Modern Phys., 34: 1-40(Jan. 1962).

A survey is presented of studies on symmetries in strong interactions of elementary particles, under the supposition that elementary particles may be thought of as linear representations of Lie groups. The Lie algebras of simple groups are reviewed, and attention is devoted to representation, composition and decomposition, and tensor analysis of Lie algebras and simple Lie groups. Illustrative applications of the Lie representations to several elementary particle schemes are outlined. (T.F.H.)

13920 DIGITAL-COMPUTER ANALYSIS OF DATA FROM BUBBLE CHAMBERS: KINEMATIC ANALYSIS OF COMPLETE EVENTS. Arthur H. Rosenfeld (Univ. of California, Berkeley) and James N. Snyder. Rev. Sci. Instr., 33: 181-95(Feb. 1962).

A digital computer program called KICK (K-meson Interaction Coplanarization and Kinematics), which analyzes complete bubble chamber events, is described. The program uses as inputs data from a single-track analysis program that previously used raw track measurements to perform the spatial reconstruction of tracks, and fitted appropriate curves to them. KICK consists of a set of general processing or analysis routines, each of which is capable of carrying out one of the unique processing steps to which a given event may have to be subjected for proper analysis, for example, "Input Event," "Fit Vertex," "Transform Variables Along Track," "Output Results," etc. Also included is a set of event-type control subroutines each of which, calling upon the proper sequence of these general processing routines, is able to carry out the desired analysis of a particular type of event. (auth)

13921 BUBBLE DENSITY MEASUREMENTS FOR PARTICLE IDENTIFICATION. R. M. Lea and C. Vittitoe (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr., 33: 243-4(Feb. 1962). (BNL-5708)

The bubble densities of protons, pions, and kaons having known momenta (between 0.15 and 4.0 Bev/c) are measured in a bubble chamber, with an uncertainty of 10%. Assuming that the bubble density varies as β^{-n}, a χ^2 fit of the data gives $n = 1.88$. The results make possible differentiation between pions and kaons below 0.8 Bev/c, and between pions and protons below 1.6 Bev/c. (T.F.H.)

13922 SOLUTION OF THE KINETIC EQUATION FOR ANISOTROPIC ELECTRON SCATTERING. A. G. Samoilovich, I. Ya. Korenblum, I. V. Dakhovskii, and V. D. Iskra (Semiconductor Inst., Academy of Science, Leningrad). Soviet Phys.-Solid State, 3: 2148-56(Apr. 1962).

The vibrational scattering of electrons is examined in an external electric field, when a temperature gradient is applied. It is assumed that the constant energy surfaces are ellipsoidal. The kinetic equation leads to an infinite

system of linear algebraic equations. A convenient equation is obtained for the coefficients of the system. The projection of the nonequilibrium correction of the distribution function on the first spherical harmonic, which is necessary for calculating the current, is established in the form of a rapidly converging series. The problem of anisotropic scattering is analyzed from the viewpoint of the method of eigenfunctions. (auth)

13923 ELEMENTARY PARTICLES. Yu. V. Novozhilov. Authorized English Edition Translated from the Russian. Russian Tracts on Advanced Mathematics and Physics. Volume XII. New York, Gordon and Breach Science Publishers, Inc., 1961. 205p. $8.00.

A development of the theory of elementary particles in modern physics is presented. The development considers the conservation principles, particles vital in explaining nuclear forces, discovery of particles, properties of strange particles, some recent achievements, and present knowledge of the particles. (N.W.R.)

Neutron Physics

Refer also to abstracts 12842 and 13351.

13924 (AD-261974) EXPERIMENTAL AND RESEARCH WORK IN NEUTRON DOSIMETRY: PHASE II. Final Summary Report, March 1–April 30, 1961. R. K. Crooks, H. C. Gorton, J. M. Swartz, and O. J. Mengali (Battelle Memorial Inst., Columbus, Ohio). May 31, 1961. Contract DA-36-039-SC-78924. 26p.

The readout problem is discussed, and the development is described of an engineering readout instrument that provides an accurate means of making radiation measurements using radiac-type detectors. Consideration was given to the measurement of 2 parameters, carrier lifetime and forward resistance, both of which are functions of the total radiation exposure of the detector. The objective was to develop an engineering model of a readout device for measuring either lifetime or forward resistance. Tests indicated that the model of the readout instrument developed was capable of measuring the forward voltage drop across the radiac detector to an accuracy of about ±5 per cent under room-temperature conditions. The radiation exposure of a given detector can therefore be determined from suitable voltage-radiation calibration curves for the detector type. (auth)

13925 (AERE-R-3931) COMPILATION OF EARLY SCATTERING LAW DATA. P. A. Egelstaff (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1962. 14p.

Data on the scattering of thermal neutrons by graphite and light and heavy water are given in tabular form. (auth)

13926 (ANL-6498) THE MODERATION OF NEUTRONS IN NON-MULTIPLYING INFINITE HOMOGENEOUS MEDIA (thesis). Kwang-Shik Min (Argonne National Lab., Ill.). Jan. 1962. Contract W-31-109-eng-38. 66p.

Submitted to Univ. of Minnesota, Minneapolis.

The gas model of neutron thermalization for a general moderator mass was studied by formulating the thermalization process as an integral equation. The relation of the model to the slowing-down theory was investigated. A discussion of the theory of scattering cross sections for neutrons is presented. The Wigner-Wilkins model was considered for moderator atoms of the same mass as the neutron. The analysis was extended to the case of a gaseous moderator with atoms of general mass. (M.C.G.)

13927 (CEA-1998) ANALYSE DES RESONANCES DUES AUX NEUTRONS "S" DANS LES EXPERIENCES DE TRANSMISSION PAR TEMPS DE VOL. I. SANS TERME D'INTERFERENCE. (Analysis of Resonances due to S Neutrons in Experiments on Transmission by Time-of-Flight. I. Without the Interference Term). C. R. Corge (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 91p.

Various methods for transmission resonance analysis of S-wave neutrons in time-of-flight experiments are described. Only cases in which the interference term may be neglected are considered. Results are given relative to a partial-area method, and to a so-called width-at-half-depth method. (tr-auth)

13928 (NAA-SR-Memo-6866) CALCULATION OF NEUTRON AGE AND MOMENTS OF THE NEUTRON SLOWING DOWN DENSITY DISTRIBUTION IN HYDROCARBONS. H. Alter (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 21, 1961. Contract [AT(11-1)-Gen-8]. 17p.

An evaluation relating to the substitution of a cold moderator in the high temperature POPR critical experiments was undertaken. One aspect of this evaluation was an attempt to "match" neutron ages for the hot and cold moderator. Calculations showed that a mixture of furfural and om-terphenyl-25% diphenyl does not satisfy the age matching requirement. The results of the calculation gave for the slowing down age of the hot and cold moderators respectively: 64.0 ± 0.5 cm^2 and 52.4 ± 0.4 cm^2. Tables and curves of the moments of the neutron slowing down distribution as a function of C/H ratio are presented. All data were normalized to a mass density of 1.0 gm/cc. There appeared to be very good agreement between data read from the curves and previously calculated results. (auth)

13929 (ORNL-TM-168) SWAPS–AN EXPERIMENTAL PROGRAM FOR NUMERICAL SOLUTION OF THE TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING IN ONE-DIMENSIONAL SLAB GEOMETRY. Melvin L. Tobias and Tom B. Fowler (Oak Ridge National Lab., Tenn.). Mar. 8, 1962. Contract [W-7405-Eng-26]. 38p.

A computer program was developed as part of an attempt to solve the neutron transport equation in as general a manner as present day machine capacity will permit. The iterative technique employed is equivalent to the EQUIPOISE method modified by a form of block relaxation. In terms of mesh sweeps, the procedure is extremely rapid by comparison with a similar program. Two energy groups, 16 angular directions, and 400 mesh points, are provided. Anisotropic scattering is permitted, and an arbitrary one-dimensional distribution of material properties can be used. Checks of the results of the program against published analytical results for both isotropic and anisotropic scattering were in excellent agreement. (auth)

13930 (TID-14821) TEMPERATURE DEPENDENCE OF THE NEUTRON TRANSPORT CROSS SECTION IN PARAFFIN AND POLYETHYLENE. Louis J. Esch (Knolls Atomic Power Lab., Schenectady, N. Y.). Feb. 15, 1962. Contract [W-31-109-Eng-52]. 74p.

For presentation at Colloquium at R.P.I., February 15, 1962.

A semi-empirical prescription describing the temperature dependence of the neutron transport cross section is presented, along with an experimental determination of the same quantity. In the prescription, an energy dependent transport cross section is calculated from the energy dependent-reduced mass of the scattering center as ob-

tained from the measured variation with energy of the total cross section of water. The present calculation uses this method but substitutes the measured total cross sections of polyethylene and paraffin. The difference between the polyethylene prescription and that for water is significant, while the difference between those for polyethylene and paraffin is small. A Maxwellian average of the transport cross sections obtained from each prescription was taken for comparison with experiment. The neutron diffusion length in paraffin was measured at 60 to 130°C. Paraffin is a liquid in this range, which permitted a simplification of the mechanical aspects of the experiment. The characteristic length for thermalization of the neutrons from the point source was shorter than the thermal-diffusion length, so that at large distances from the source, the spatial distribution of the neutron flux was that from thermal neutrons alone. The activity of manganese foils placed in this thermal flux was used to determine the form of the spatial distribution, and thus the thermal-diffusion length. The data were corrected for foil weight, foil flux depression, thermal expansion of foil holders, and neutron slowing down density. The average transport cross section was abstracted from the measured diffusion length, and the results compared with the predictions of the water and paraffin prescriptions, and with experimental points for water. The comparison supports the significance of the difference between the prescriptions. Several past calculational-experimental comparisons have been rechecked using the polyethylene prescription in place of the water prescription in computer codes. In all cases the agreement between calculation and experiment was improved by the use of the proper prescription. The values obtained for the Maxwellian average transport cross section in paraffin by prescription and experiment are tabulated. While the experimental values are consistently lower than those predicted by the prescription, the two agree within their associated errors. (auth)

13931 (UCRL-6604) BANZAI, A ONE-DIMENSIONAL MULTIENERGY GROUP NEUTRON TRANSPORT CODE FOR THE IBM 709 AND 7090 SYSTEMS. T. F. Wales and R. N. Stuart (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 24, 1961. Contract W-7405-eng-48. 167p.

The previous numerical attacks on the neutron transport equation were primarily limited to the solution of the equation in its differential forms as exemplified by the various spherical harmonic and SN programs. A different approach, viz., the numerical solution of the integral transport equation is described. The principal advantage in this approach is that the scalar flux (and hence the vector flux) is obtained exactly. Problems in which the vector flux changes sharply due to discontinuities in the moderating medium may be solved. This is a particularly useful feature for investigating boundary effects. (auth)

13932 (UCRL-6721) SOLUTIONS OF A FAMILY OF NONLINEAR DIFFUSION EQUATIONS FOR SEMI-INFINITE MEDIA. Ray E. Kidder (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 11, 1962. Contract W-7405-Eng-48. 10p.

Solutions $P(x,t)$ of the nonlinear diffusion equation $\partial P/\partial t = \partial^2 P^n/\partial x^2$ are obtained for a series of values of the exponent n ($1 \leq n < \infty$). A diffusion equation of this form arises in a variety of physical problems. In particular, the equation appears in problems where the heat capacity, thermal conductivity, diffusivity, opacity, etc., can be approximately represented by power laws in terms of the dependent variable. Because of the frequency with which diffusion equations of this type occur, it was considered worthwhile to obtain the solutions from them for a wide range of values of n. The results are presented in convenient graphical form. (auth)

13933 THE RAY LENGTH IN THE PARAMAGNETIC SCATTERING OF SLOW NEUTRONS BY THE RARE EARTHS. Daniel Saint-James. Compt. rend., 253: 2884-6(Dec. 18, 1961). (In French)

The effect of the exchange between magnetic ions on the elastic and inelastic scattering of neutrons by rare earth ions exposed to the action of a crystalline field was studied. In general, the ray length does not tend toward zero with the length of the scattering vector. The calculation is applied to the case of Ce^{3+} ions in a cubic field. (tr-auth)

13934 ABSOLUTE CALIBRATIONS OF THERMAL NEUTRON FLUX DENSITIES. Taichi Michikawa, Bunji Furubayashi, Eizo Teranishi, and Yajiro Inoue (Electrotechnical Lab., Tokyo). Denki Shikensho Ihô, 25: 843-9 (Nov. 1961). (In English)

The thermal neutron flux densities in a 190 × 170 × 190 cm graphite standard pile were calibrated by means of absolute measurements of induced activities in gold foils irradiated in these thermal neutron fluxes. The activities were measured with a $4\pi\ \beta-\gamma$ coincidence counter. The thermal neutron flux densities (nv_0) at r = 30, 50, and 70 cm along the axis of 190 cm were 14.0×10^3, 7.66×10^3, and 3.47×10^3 n/cm^2/sec, respectively. The estimated accuracy was ±1.9%. The average fluxes $n\bar{v}$ were also determined taking into account the effect of the epithermal neutrons. These values were 16.0×10^3 and 8.71×10^3 n/cm^2/sec at r = 30 and 50 cm, respectively. (auth)

13935 ON THE CALCULATION OF LOW-ENERGY NEUTRON SCATTERING BY A COMPLEX POTENTIAL. Arundhati Ghosh and S. K. Dutta (Indian Assn. for the Cultivation of Science, Calcutta). Indian J. Phys., 35: 550-5(Nov. 1961).

The scattering of low-energy neutrons by a potential $V(r) = -(V + iW)\ [1 + e^{(r-R)/a}]^{-1}$ is calculated by applying a method of Lanczos for solving the Schrödinger equation. The neutron strength function $\overline{\Gamma}_n^0/D$, which is the ratio of the average value of neutron width to level spacing, is obtained from the scattering amplitude. That this analytic method of solution is fairly exact is borne out by assessment of results with the finding of H. Feshbach, C. Porter, and V. F. Weisskopf (Phys. Rev., 96: 448(1954)) who solved numerically the differential equation with the same potential. (auth)

13936 ON THE NUMBER OF COLLISIONS TO SLOW DOWN NEUTRONS FROM HIGH SPEEDS. Coleridge A. Wilkins (Univ. of New South Wales, Sydney). J. Proc. Roy. Soc. N. S. Wales, 95: 147-52(1961).

Explicit forms for the distribution of the number of collisions to cross a finite energy interval are given for hydrogen and absorption, and a single nuclear species without absorption. In the latter case, a moment generating function equation is derived. The case of a single nuclide with constant absorption is summarized, and a general equation for the higher moments of the distribution of the number of collisions to escape a narrow resonance for a given initial collision in the resonance region is found. (auth)

13937 THE SCATTERING OF SLOW NEUTRONS BY A PLANE-PARALLEL CRYSTAL PLATE. A. A. Atanasov (Technological Inst. for the Food Industry, Plovdiv, Bulgaria). Soviet Phys.-Solid State, 3: 2272-7(Apr. 1962).

The problem of scattering of slow neutrons by a plane-

parallel crystal plate is considered in the most general form. The method is that used for electromagnetic waves, and it can be used to calculate the neutrons secondarily scattered by nuclei. The maxima of the optical waves of the transmitted and reflected neutrons are double. (auth)

13938 THE THEORY OF INELASTIC SCATTERING OF NEUTRONS BY IMPURITY CENTERS IN CRYSTALS. V. N. Kashcheev and M. A. Krivoglaz (Inst. of Physics, Riga, and Inst. of Metal Physics, (Kiev) Latvian SSR. Soviet Phys.-Solid State, 3: 2301-9(Apr. 1962).

Nuclear and magnetic scattering of neutrons by impurity centers in crystals were studied under conditions where the scattering is accompanied by electron transitions in the centers. The computation is performed in the weak coupling approximation and in the adiabatic approximation for the cases where the heat evolved for an electron transition in the center is large and small. For weak coupling the possibility of nuclear scattering arises when electron-phonon interaction is taken into account; in the case of the adiabatic approximation this possibility arises when the nonadiabaticity of the system is taken into account. The energy distribution of the scattered neutrons is determined. Estimates of the theoretical parameters are made for impurity centers in ionic crystals. (auth)

Nuclear Properties and Reactions

13939 (ARF-1166-18) STUDIES OF NUCLEAR RESONANT ABSORPTION OF GAMMA RAYS. Quarterly Report No. 5 Covering Period September 1 to November 30, 1961. James J. Ezop (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Mar. 7, 1962. Contract AT(11-1)-578. 7p.

In experiments to determine if there is any change in the fraction of recoil-free emissions of gamma radiation from Fe^{57} due to pressure increases, no measurable changes were found at pressures up to 40,000 psi. Experimental apparatus is being developed to measure the acoustical power of transducers in the megacycle frequency range using nuclear resonance techniques. (J.R.D.)

13940 (CNLM-1802-10) SELF-SHIELDING CROSS SECTIONS. E. A. Cernak, comp. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Dec. 29, 1959. Contract [AT(11-1)-229]. 7p.

A bibliography containing 37 references on self-shielding cross sections is presented. The bibliography is limited to the period from 1951 through November 1959 with the references arranged alphabetically by title. The bibliographic sources were Abstracts of Classified Reports and Nuclear Science Abstracts. (auth)

13941 (DC 58-1-30) GAMMA RAY ENERGY SPECTRA FROM THERMAL NEUTRON CAPTURE. F. E. Deloume (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 2, 1958. Contract AT(11-1)-171. 58p.

Energy spectra of gamma rays resulting from thermal neutron capture are compiled for forty-nine elements. The data are presented in both graphical and tabular form. Thermal neutron capture cross sections, isotopic abundances, binding energies of the extra neutron in the isotopes, and weighted average binding energies are also tabulated. (auth)

13942 (DC-58-1-90) NEUTRON SPECTRA FOR Ra-Be, Po-Be, AND Pu-Be SOURCES. Mary J. Stanley (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 18, 1957. Contract AT(11-1)-171. 7p.

The compilation for the nuclear data tape of fission neutron spectra of Ra-Be, Po-Be, and Pu-Be sources is described. These spectra are needed for the analysis of experimental data. (auth)

13943 (DC-60-1-177) DISTRIBUTION OF THE ENERGY PER FISSION FOR U^{235}. M. R. Smith (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 11, 1960. Contract [AT(11-1)-171]. 25p.

A literature search was conducted to compile a recent tabulation for the distribution of the fission energy of U^{235}. It is concluded that the energy released when an atom of U^{235} undergoes thermal-neutron-induced fission can be classified into six components the total of which is 201.39 Mev. A tabulation of the energy components is included. (J.R.D.)

13944 (DESY-A2.85) PHÄNOMENOLOGISCHE THEORIE ZUR BERECHNUNG EINER KASKADE AUS SCHWEREN TEILCHEN (NUKLEONENKASKADE) IN DER MATERIE. (Phenomenological Theory for Calculation of a Cascade of Heavy Particles (Nuclear Cascade) in Matter). C. Passow (Deutsches Elektronen-Synchrotron, Hamburg). Feb. 1962. 32p.

If a high-energy heavy particle enters dense matter, a cascade will be released. The diffusion equations for the number of protons, neutrons, and pions as a function of the depth of penetration of the matter were solved for a phenomenological statement for the effective cross sections of nuclear processes with more than one secondary particle. Although in the literature a statement for this effective cross section of $\sim g(E_0/E)$ was chiefly calculated, the general statement CE_0^l/E^n was used in this study. Moreover the theory for dense matter was used so that the π-mesons were also involved in the nuclear collisions. The energy losses of the charged particles by means of ionization were given by cutoff-parameter calculations. The number of μ-mesons was also ascertained as a function of the depth of penetration. (tr-auth)

13945 (JINR-P-830) ISSLEDOVANIE REAKTSII C^{12}(t, p)C^{14}. (Investigation of the C^{12}(t, p)C^{14} Reaction). B. Kyun, V. I. Salatskii, and I. V. Sizov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1961. 15p.

The differential cross sections for the reaction C^{12}(t,p)C^{14} are measured to the ground state of the residual C^{14} nucleus. The measurements are performed at a laboratory angle of 90°, in the triton energy range of 0.32 to 1.18 Mev. For some energies in this interval, the proton angular distributions are measured at laboratory angles of 0 to 115°. The total cross sections are obtained at triton energies of 0.37 to 1.16 Mev. (tr-auth)

13946 (JINR-P-845) ENERGETICHESKII SPEKTR REZONANSNOGO POGLOSHCHENIYA γ-IZLUCHENIYA 92 KEV Zn^{67} V OKISI TSINKA. (Resonance Absorption Spectrum of 92 kev Zn^{67} γ emission in Zinc Oxide). V. P. Alfimenkov, Yu. M. Ostanevich, T. Ruskov, A. V. Strelkov, F. L. Shapiro, and Wu-kuang Yen (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1961. 16p.

Experiments using the Doppler shift and frequency modulation were carried out to observe the Mössbauer effect on the 92-kev gamma transition in Zn^{67}. Zinc oxide was used as a source and absorber. The observed magnitude of the resonance was found to be 2×10^{-3}. The width of the line was somewhat larger than the natural one. At the available accuracy of the measurements, a structure which was difficult to interpret was observed in the spectrum. (auth)

13947 (JINR-P-866) POLUCHENIE Md^{256} PRI OBLUCHENII U^{238} IONAMI Ne^{22} I IZUCHENIE EGO NEKOTORYKH KHIMICHESKIKH SVOISTV. (Production of Md^{256} in U^{238} Bombardment by Ne^{22} Ions and Studies of its Chemical Properties). G. Beranova, I. Brandshtetr, V. Druin, V. Ermakov, T. Zvarova, M. Krzhivanek, Ya. Maly, S. Polikanov, and Hung-kung Su (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1962. 11p.

In bombarding U^{238} by Ne^{22}, Md^{256} was obtained. The distribution coefficient of Md for ammonium lactate, α-hydroxyisobutyrate, and citrate was found by means of the chromatographic separation of actinide elements and rare earths on Dowex-50. (auth)

13948 (JINR-P-875) IZMERENIE PERIODA SPONTANNOGO DELENIYA IZOTOPA FERMIYA Fm^{252}. (Measurements of Spontaneous Fission of Fm^{252} Isotope). V. A. Druin, I. Brandshtetr, and Ya. Maly (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1962. 12p.

By bombarding U^{238} with Ne^{22} nuclei, $\sim 2.75 \cdot 10^5$ of Fm^{252} nuclei were synthesized in the multiple-charged ion cyclotron. The period of the spontaneous fission of this isotope was found to be (140 ± 160) years. (auth)

13949 (JINR-P-877) ZAMECHANIE K EKSPERIMENTAL'NOMU ISSLEDOVANIYU STRUKTURY VEKTORNOGO TOKA V SLABOM VZAIMODEISTVII. (Remarks on the Experimental Investigation of the Vector Current Structure in Weak Interactions). Nguyen Van-hieu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 6p.

It is shown that some hypotheses about the structure of the vector current in weak interactions can be verified by investigating experimentally the processes of the type neutrino + baryon → charged lepton + baryon + meson. (auth)

13950 (JINR-P-887) UCHET DVUNUKLONNYKH KORRELYATSII V TEORII μ^--ZAKHVATA LEGKIMI YADRAMI. (Two-nucleon Correlations in the Theory of μ^- capture by Light Nuclei). V. V. Balashov, V. B. Belyaev, and R. A. Eramzhyan (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 11p.

Within the scheme of the intermediate coupling, the effect of the residual interactions between nucleons in a nucleus on the probabilities of the partial transitions in the reaction $O^{16} + \mu^- \rightarrow N^{16} + \nu$ is investigated. It is shown that the account of the two-nucleon correlations leads to a change in the calculated transition probabilities by a factor of 1.5 to 2 compared with the one-particle model. (auth)

13951 (JINR-P-898) SPONTANNOE DELENIE S ANOMAL'NO KOROTKIM PERIODOM. I. (Spontaneous Fission with Abnormally Short Period. [Part] I). S. M. Polikanov, A. V. Druin, V. A. Karnaukhov, V. L. Mikheev, A. A. Pleve, N. K. Skobelev, V. G. Subbotin, G. M. Ter-Akop'yan, and V. A. Fomichev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1962. 17p.

The internal beam of the Joint Institute cyclotron was used for bombarding U^{238} with accelerated ions of Ne^{22} and O^{16}. Using the ionization chambers, the fragments from the spontaneous fission of an unknown isotope with a half life of about 0.02 sec were detected. It is assumed that the nucleus produced is in the isomeric state, the probability of the spontaneous fission being greater than the usual one (more than 10^9 times). It follows from the experimental data that the atomic number of this isotope $Z \leq 100$. (auth)

13952 (JÜL-28-KP) DIE SPEKTREN DER PROTONEN AUS (d,p)-REAKTIONEN AN SCHWEREN KERNEN BEI DEUTERONENENERGIEN UNTER 12 MeV. (The Proton Spectrum from (d,p)-Reactions on Heavy Nuclei at Deuteron Energies below 12 Mev). J. Pfleger, U. Schmidt-Rohr, and P. Turek (Max-Planck-Institut für Kernphysik, Heidelberg). Nov. 1961. 12p.

The proton spectra of the (d,p) reactions on heavy nuclei show, in addition to the low-energy continuum and the gross structure at higher energies, a pronounced proton group. The relative intensity of the proton group increases with decreasing deuteron incident energy. The dependence of the spectra on the atomic number of the target, as well as the energy dependence and angular distribution for Au, are measured. The results are explained in terms of the properties of the nuclear surface. (auth)

13953 (JÜL-30-KP) ENERGY DEPENDENCE OF DEUTERON SCATTERING BY MAGNESIUM. C. Mayer-Boericke, R. Santo, and U. Schmidt-Rohr (Kernforschungsanlage, Jülich, Germany and Max-Planck-Institut für Kernphysik, Heidelberg). Nov. 1961. 39p.

The angular distributions of elastic and inelastic (Q = −1.37 Mev) deuteron scattering from Mg were measured at 8.65, 9.97, 10.87, and 11.80 Mev in 5° steps. These results as well as those from other authors are discussed in terms of a diffraction scattering model. In the range of deuteron-energies from 8 to 22 Mev, the interaction radii deduced from elastic data decrease slightly with increasing energy. The interaction radii from the analysis of the inelastic scattering data do not agree in all cases studied with the corresponding radii from elastic data. The deformation parameter for Mg^{24} was found to be $|\beta_2| = 0.22$. Tables of all inelastic 11.8-Mev deuteron scattering data are presented. (auth)

13954 (NAA-SR-Memo-6760) NEUTRON CROSS SECTION AND ANGULAR DISTRIBUTION DATA FOR MONTE CARLO CALCULATIONS INVOLVING CARBON, OXYGEN, ALUMINUM AND TIN. Harry Alter (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 26, 1961. Contract [AT(11-1)-Gen-8]. 72p.

Neutron cross-section and angular-distribution data are presented for carbon, oxygen, aluminum, and tin, in the energy range, 1.0 to 10.4 Mev. The carbon and oxygen information was revised and up-dated from that presented previously. Angular distribution coefficients were derived from data given in the center-of-mass coordinate system. (auth)

13955 (NP-11375) OBSERVATION DE QUELQUES REACTIONS NUCLEAIRES PRODUITES PAR DES IONS DE ^6Li SUR LE CARBONE. (Observations on Nuclear Reactions Produced by Li^6 Ions on Carbon). Pham-Dinh-Lien (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay) and L. Marquez (Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas). Aug. 4, 1961. 8p. (Notas de Fisica, Vol. VIII, No. 11 (p.187-93)).

Results of a study concerning the reaction of Li^6 at energies up to 2 Mev on C^{12} are presented. Scintillation counter results indicate that the reaction $C^{12}(Li_6,\alpha)N^{14}$ is the most important one. (J.R.D.)

13956 (NP-11401) DECAY STUDIES OF THE EVEN-EVEN ISOTOPES, Er^{172} AND Dy^{168}. Ray Gunnink and A. W. Stoner (Industrial Reactor Labs., Inc., Plainsboro, N. J.). [1961]. Contract AF49(638)-815. 24p.

Er^{172} and Dy^{168}, with half-lives of 48.7 ± 0.5 and 81.8 ± 0.2 hours respectively, are produced by double neutron capture in Er^{170} and Dy^{164}. Gamma rays of the following energies

are found in the decay of Er^{172}: two coincident 50 kev radiations, and 72, 128, 170, 200, 410, 440, and 610 kev. The proposed energy levels for Tm^{172} consistent with the data are at 410, 440, 482, 538, and 610 kev. Log ft values of beta transitions indicate that the 538 and 610 kev levels have spin assignments of 0 or 1 with positive parity. The following gamma transitions are found in the decay of Dy^{166}: 84, 291, 343, 373, and 427 kev. In addition to showing conversion electrons of the 84-kev transition, permanent magnet spectrometer studies reveal the presence of two additional transitions of 30 and 54 kev that are not observed in scintillation studies. The multipolarity of the low energy transitions are as follows: 30 kev-M1, 54 kev-E2, and 84 kev-M1. The proposed energy levels for Ho^{166} are at 54, 84, 375, and 427 kev. (auth)

13957 (NP-11403) NUCLEAR CHEMISTRY OF SHORT-LIVED ISOTOPES. Final Report. A. W. Stoner and Ray Gunnink (Industrial Reactor Lab., Inc., Plainsboro, N. J.). Feb. 28, 1962. Contract AF49(638)-815. 6p.

Studies are reported of the nuclear decay of isotopes in the rare earth region. Particular interest centers about the isotopes Sm^{150}, Dy^{166}, and Er^{172}, because these isotopes are among the very few examples of even-even nuclides of high nuclear deformation decaying to the excited states of odd-odd nuclides. Many of the nuclear energy levels and essential features of the decay of these isotopes are characterized. The resulting decay schemes are compared with nuclear energy level assignments as predicted by the collective model. (auth)

13958 (NP-11422) OBSERVATIONS ON THE PRODUCTION OF TWO CHARGED PIONS BY NEGATIVE PIONS AT 14 AND 16 AND 17 GeV. F. Baldassarre, A. Wataghin, et al. (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). 1961. 11p. (Notas de Fisica, Vol.VIII, No. 19 (p.343-52)).

Investigations concerned with the interactions of negative pions at 14, 16, and 17 Bev are described. An analysis of the types of events in which the target nucleus excitation cannot be detected experimentally is emphasized. Results on elastic scattering, diffraction, dissociation, and coulomb dissociation of the incident pion are of most concern. (J.R.D.)

13959 (NP-11566) THE SCATTERING OF 11 MEV–19 MEV MONOCHROMATIC GAMMA RAYS BY THE DEFORMED NUCLEUS, Ho^{165} (thesis). Technical Report No. 33. P. A. Tipler, P. Axel, N. Stein, and D. Sutton (Illinois. Univ., Urbana. Physics Research Lab.). Feb. 1962. Contract ONR 1834(05). 93p.

The measurement of the cross section at 135° for scattering of gamma radiation by Ho^{165} is described. Theoretical aspects are discussed and the experimental apparatus including the monochromator is described along with procedures. Results are analyzed and conclusions are presented. (J.R.D.)

13960 (NP-11571) THE NUCLEAR PROPERTIES OF RHENIUM. Ninth Quarterly Technical Progress Report, December 8, 1961–March 8, 1962. R. A. Karam, T. F. Parkinson, and F. J. Munno (Florida. Univ., Gainesville). Contract NOas-60-6021-c. 11p.

The nuclear reactions $Re^{185}(n,p)W^{185}$, $Re^{187}(n,p)W^{187}$, $Re^{185}(n,\alpha)Ta^{182}$, $Re^{187}(n,\alpha)Ta^{184}$, $Re^{185}(n,2n)Re^{184}$ and $Re^{187}(n,2n)Re^{186}$ with 14-Mev neutrons are discussed theoretically. It appears that the (n,α) reactions are not possible. The (n,p) reactions are possible but not very probable. The (n,2n) reactions have the largest cross sections of any of these reactions. The $Re^{187}(n,2n)Re^{186}$ reactions cross section was calculated to be 2.3 barns compared to a preliminary experimental value of 2.49 ± 50% barns. (auth)

13961 (NP-11594) PHOTOPRODUCTION OF POSITIVE PIONS FROM HYDROGEN NEAR THRESHOLD. PART II. POSITRON DECAY COUNTING METHOD. Technical Report No. 32. Richard A. Carrigan and Edwin L. Goldwasser (Illinois. Univ., Urbana. Physics Research Lab.). Feb. 1962. Contract ONR 1834(05). 191p.

Experiments were conducted in which the photoproduction of π^+ from hydrogen was studied by detection of the positrons from the muons produced by π^+ decay. Values of the total cross section were obtained near threshold as a function of energy. Different methods used to analyze the data are compared, and the discrepancies between the results and theory are discussed. Equipment and methods used in the experiments are described in detail. (D.L.C.)

13962 (PAN-253/VI) NOTE ON THE AZIMUTHAL ANGULAR DISTRIBUTION OF SLOW PARTICLES IN HIGH ENERGY INTERACTIONS. P. Ciok, M. Danysz, T. Saniewska, and P. Zieliński (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 8p.

In a sample of 37 high energy nuclear interactions ($E_p > 10^{10}$ ev) of singly charged primaries with heavy nuclei of the emulsion ($N_h > 8$), the azimuthal angular distribution of slow secondaries was analyzed. The observed angular distribution is consistent with the assumption of an azimuthal isotropy. (auth)

13963 (PAN-255/VI) PROTON-PROTON ELASTIC SCATTERING CROSS SECTIONS IN THE 1.5 TO 9 Bev RANGE. E. Marquit (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 17p.

Data on p-p elastic scattering in the 1.5 to 9 Bev range are discussed. It was concluded that owing to uncorrected experimental biases which generally increase the energy, the reported values of the p-p elastic scattering cross section σ_e should be regarded as lower limits. An upper limit of $\sigma_e \approx 20$ mb was estimated for the 1.5 to 9 Bev range. (auth)

13964 (PAN-258/VII) CALCULATION OF THE OPTICAL POTENTIAL WITH THE NUCLEON-NUCLEON PHASE SHIFTS IN THE THOMAS-FERMI APPROXIMATION. J. Dąbrowski, A. Sobiczewski, and M. Zielińska (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 13p.

The radial dependence of the optical potential for nucleon-nucleus scattering is calculated with the help of the empirical nuclear density. The nucleus is approximated locally by the Fermi model. The equation for the scattering in the nuclear medium is solved approximately, and the optical potential is expressed with the help of nucleon-nucleon phase shifts. In the numerical computations the Signell-Marshak phase shifts are used. The effect of the exclusion principle increases the depth of the real part and decreases the depth of the imaginary part of the optical potential in the center of the nucleus. The radius of the real part is practically equal to the radius of the density distribution, whereas the radius of the imaginary part is slightly bigger. The results are compared with the experimental estimates of the optical potential. (auth)

13965 (PAN-281/VII) CALCULATION OF THE OPTICAL POTENTIAL WITH THE NUCLEON-NUCLEON PHASE SHIFTS IN THE THOMAS-FERMI APPROXIMATION. [PART] II. Adam Sobiczewski and Małgorzata Zielińska (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Nov. 1961. 8p.

The radial dependence of the optical potential for nucleon-nucleus scattering is calculated with the help of the empiri-

cal nuclear density. The nucleus is approximated locally by the Fermi model. The equation for the scattering in the nuclear medium is solved approximately, and the optical potential is expressed with the help of nucleon-nucleon phase shifts. In the numerical computations the latest Yale phase shifts are used. In comparison with the analogical calculation based on the Signell-Marshak phase shifts, the radius and the surface thickness of both the real and the imaginary part of the optical potential practically do not change; the depths of the optical potential increase—a little (less than 8%, i.e., less than 2 Mev) for the imaginary part and up to 35%, i.e., up to 15 Mev, for the real part—in the center of the nucleus. (auth)

13966 (PAN-286/VI) FREQUENCY OF THE EMISSION OF ^{8}Li, ^{8}B AND ^{9}Li FRAGMENTS FROM INTERACTIONS OF 9 GeV PROTONS WITH HEAVY EMULSION NUCLEI. Wojciech Gajewski, Jerzy Pniewski, Tadeusz Pniewski, Jolanta Siemińska, Marta Sołtan, Krzysztof Sołtyński, and Joanna Suchorzewska (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1961. 27p.

Ca 200 hammer tracks from primary 9 Bev proton interactions with heavy emulsion nuclei were collected. An analysis of possible biases was done in a sample of some 100 hammer tracks not limited in inclination. Using a width measurement method and correcting the results for the inclined tracks, the B fragments were separated from Li fragments in 90 to 95% of all the events. The full kinematical analysis of Li^{9} decay and critical analysis of measurement data made it possible to draw some conclusions concerning the method of identification and the relative frequency of emission of these fragments. The energy spectrum of α's from Li^{8} decay was found and compared with other theoretical and experimental results. (auth)

13967 s- AND p-WAVE NEUTRON SPECTROSCOPY. PART VIII. SUBSHELL EFFECT ON NUCLEAR LEVEL SPACING NEAR A = 50. C. D. Bowman, E. G. Bilpuch, and H. W. Newson (Duke Univ., Durham, N. C.). Ann. Phys. (N. Y.), 17: 319-78(Mar. 1962).

The neutron total cross sections of separated isotopes of even A targets near A = 50 were measured with high resolution using the $Li^{7}(p,n)Be^{7}$ reaction as the neutron source for a 20° collimator. The measurements on Ca^{40}, Cr^{52}, Fe^{54}, and Fe^{56} are characterized by narrow $l > 0$ resonances superimposed on wider but easily distinguishable s-wave resonances. The Ti^{46}, Ti^{48}, and Ti^{50} nuclei exhibit a large enough proportion of these $l > 0$ resonances to complicate identification of s-wave resonances. Since the usefulness of area analysis is limited by strong resonance-resonance and resonance-potential interference, a multilevel formula obtained from the R-matrix formalism was used to fit the wide s-wave resonances. After correcting the resulting $\frac{1}{2}+$ level spacings to zero angular momentum and for variations in excitation energy, two other important influences on level spacing were observed; the neutron excess effect and the subshell effects. The former phenomenon was verified beyond reasonable doubt and the latter, which results from the influence of ground-state subshell occupation on the level spacing at higher excitation energy, is consistent with Rosenzweig's predictions. The moment of inertia of some of these nuclei when excited to the neutron separation energy were determined. They apparently fluctuate widely around the rigid body value, but, on the average, are slightly higher. Distributions of widths and spacings are in agreement with predictions. (auth)

13968 COMPARISON OF THE KINETIC ENERGIES OF FISSION FRAGMENTS OF U-238 PRODUCED BY 3- AND 15-MEV NEUTRONS. I. A. Baranov, A. N. Protopopov, and V. P. Eĭsmont. Atomnaya Energ., 12: 150-1 (Feb. 1962). (In Russian)

An attempt was made to determine whether the kinetic energy of fission fragments is dependent on the level of excitation of the fissioning nucleus. Neutrons with energies of 3 and 15 Mev were generated by the $D(d,n)He^{3}$ and $T(d,n)He^{4}$ reactions, respectively. A 450 microgram/cm^{2} natural U target was used, determining the energy of the fission fragments with a double ionization chamber and recording simultaneously the pulse amplitudes resulting from the fragment pairs. For each mass ratio the energy distribution and the highest probable kinetic energy of the 2 fragments were determined. It was found that for mass ratios of 1.25 to 1.65 the highest energy is obtained with 3-Mev neutrons. The relatively small differences indicate that the kinetic energy is obtained at the expense of the Coulomb repulsion forces as the distance between charge centers does not change with the excitation level. The data do not agree with the results of the calorimetric study of P. Stevenson et al. (Phys. Rev., 117: 186(1960)). (TTT)

13969 NEW MEASUREMENTS OF THE AGE OF NEUTRONS FROM THE FISSION OF U^{235} IN HYDROGENEOUS MATERIALS. L. N. Yurova, A. A. Polyakov, and A. A. Ignatov. Atomnaya Energ., 12: 151-2(Feb. 1962). (In Russian)

In view of the difference between experimental and theoretical values of the neutron age, energy distribution measurements were undertaken on the 1.46-ev neutrons formed by the slowing down of the fission neutrons of U^{235} in H_2O and in monoisopropyl biphenyl, $C_{15}H_{16}$. The neutron age measurements were carried out with the help of an In detector in a stainless steel container placed in the thermal column of the reactor, using highly enriched U as the neutron source. The sources were 0.3 and 1.8-mm thick. The neutron age data obtained with the 0.3-mm thick source do not contradict the calculated values and agree satisfactorily with the values of τ (1.46 ev) = (27.3 ± 0.9) mm^{2} corresponding to source with 0 thickness, reported by D. Lombard and C. Blanchard (Nuclear Sci. and Eng. 7: 5(1960)). (TTT)

13970 EFFECT OF THE RESONANCE ABSORBER ON THE ABSORPTION OF THE SLOWING-DOWN NEUTRONS BY A NUCLEUS WITH A SMOOTHLY CHANGING ABSORPTION CROSS SECTION. T. V. Golashvili. Atomnaya Energ., 12: 155-6(Feb. 1962). (In Russian)

Formulas were derived for calculating the shielding coefficients and the effective capture cross section, taking into account the resonance absorber; these formulas apply specifically for the case in which the capture cross section of the nucleus changes only slightly with the energy. The derived equations were used for calculating the shielding coefficient of U^{235} in the energy range of 66 ev ≤ E ≤ 1000 ev, taking into consideration the pressure of the admixed absorber, U^{238}, in the system. On the basis of the U^{238} resonance parameters given in the Neutron Cross Section Atlas (D. Hughes et al., McGraw Hill Co. 1960) the following results were obtained: for natural U—$K_{shielding}$ = 0.8363; for the 10% enriched material—$K_{shielding}$ = 0.8584. The total absorption cross section values of U^{238} used in the calculations are tabulated. (TTT)

13971 CROSS SECTION FOR THE FORMATION OF SODIUM BY THE REACTION $Al^{27}(p,3p,3n)Na^{22}$ AT 155 MEV. Nguyen-Long-Den (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). Compt. rend., 253: 2919-21 (Dec. 18, 1961). (In French)

The cross section of the reaction $Al^{27}(p,3p,3n)Na^{22}$ at

155 Mev was determined by two different methods. The value $\sigma Na^{22}/\sigma Na^{24} = 1.92 \pm 0.06$ was obtained. (tr-auth)

13972 THE SPECTRUM OF THE ELECTRONS EMITTED DURING THE β DECAY OF PLATINUM-191. José Sant'Ana Dionisio (Laboratoire de l'Aimant-Permanent du Centre National de la Recherche Scientifique, Orsay, France). Compt. rend., 253: 2933-5(Dec. 18, 1961). (In French)

The Auger electron and the internal conversion spectra emitted during the decay $Pt^{191}-Ir^{191}$ were studied in the energy range from 0 to 116 kev with two magnetic spectrographs with semi-circular focusing (one with pre-acceleration). The nature and multipolarity order of the γ radiations at 82.46 and 96.48 kev were established. (tr-auth)

13973 THE NATURE OF THE 29-KEV TRANSITION OF PROTACTINIUM-234 (UX_2). Jean-Pierre Briand. Compt. rend., 254: 84-6(Jan. 3, 1962). (In French)

The L conversion coefficient of the 29-kev radiation of Pa^{234} was found to be higher than 140. The study of the relative intensities of the X_L rays (α, β, and γ), which accompany the internal conversion of this radiation, gives indications on the nature of this transition. (tr-auth)

13974 EVALUATION OF THE ATTRACTIVE POTENTIAL BETWEEN TWO NUCLEI OF LITHIUM-6. Christiane De Laet. Compt. rend., 254: 87-9(Jan. 3, 1962). (In French)

The quasi-molecular interaction between two nuclei of Li^6 was calculated by the variational method. The interaction is assumed to be produced by the two p neutrons. (tr-auth)

13975 THE STUDY OF RADIOACTIVE RADIATION OF NEUTRON DEFICIENT Hf ISOTOPES. V. Brabec (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague and Charles Univ., Prague), B. Kracfk, Z. Miligui, M. Vejs, A. Maštalka, M. Vobecký, T. Kracíková, and V. Hnatowicz. Czechoslov. J. Phys., B 11: 874-5(1961). (In Russian)

Short-life Hf^{171}($T_{½}$ = 16 h) and Hf^{173}($T_{½}$ = 24 h) were identified and measured in the spectral region 30 to 305 kev with a β spectrometer. The measurements are tabulated. The γ transitions measured with a scintillation spectrometer indicate 100- and 170-kev transitions for Hf^{171} and 130- and 310-kev for Hf^{173}. Indications of 98-, 210-, and 270-kev transitons were also observed but not confirmed. (R.V.J.)

13976 INFLUENCE OF PAIR FORCES ON THE GIANT RESONANCE ENERGY. L'. Majling (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B 12: 12-20(1962). (In Russian)

The influence of nucleon-nucleon forces on the giant resonance energy is investigated using the sum rules. The dependence of the contribution of exchange forces to the integral cross section of the gamma quantum absorption on the number of protons and neutrons is obtained for light nuclei. (auth)

13977 PERIODICITY IN NUCLEAR BINDING ENERGY AND CORRELATION BETWEEN THE ISOTOPES OF DIFFERENT NUCLEI. A. K. Dutta (Univ. Coll. of Science, Calcutta). Indian J. Phys., 35: 591-3(Nov. 1961).

Binding energies of nuclei were measured by the difference between the observed masses of the nuclei and the sum of the masses of the constituent nucleons. Data are analyzed, and a systematic deviation in the relation $E = -a_1 A + a_2 A^{⅔} + a_3 (Z^2/A^{⅓}) = a_4 (N-Z)^2/(4A)$; where A is the atomic number, N and Z are the numbers of neutrons and protons, and a_1, a_2, a_3, and a_4 are constants fixed by actual comparisons; is found. Calculations are represented in graphical form. (L.N.N.)

13978 EXPERIMENTAL INVESTIGATIONS ON A Sr^{90} BREMSSTRAHLUNG SOURCE. F. Hartmann and V. Schuricht (Technische Universität, Dresden). Isotopentechnik, 1: 225-8(Nov. 1961). (In German)

Factors important to the design of a β bremsstrahlung source are investigated experimentally with respect to the use of Sr^{90} bremsstrahlung. (tr-auth)

13979 THE MASS DISTRIBUTION IN FISSION OF LEAD INDUCED BY 54 Mev PROTONS. U. L. Vallinder and A. C. Pappas (Univ. of Uppsala). J. Inorg. & Nuclear Chem., 22: 161-7(Dec. 1961). (In English)

The mass distribution in fission of natural lead induced by 54 Mev protons was studied. The yield mass curve seems nearly symmetric in character around mass number 102. It has a width of about 28 mass units at half the maximum yield. The fission cross section is 13 ± 4 mb, which is the same as for bismuth under comparable conditions. (auth)

13980 (p,p xn) REACTIONS ON CESIUM. C. Riehl (Laboratoire de Physique Nucléaire, Orsay, France). J. phys. radium, 22: 770-1(Nov. 1961). (In French)

In cesium targets, in the form of CsCl powder, irradiated with protons from 30 to 155 Mev, the isotopes Cs^{132}, Cs^{131}, Cs^{129}, and Cs^{127} were observed, and their formation cross sections were determined. The isotopes decay essentially by electron capture on the K level. The values obtained for the cross sections are shown graphically as a function of the proton energy. The results are interpreted according to the classical scheme of spallation reactions (direct interaction and evaporation). (J.S.R.)

13981 THE MECHANISM OF THE $C^{12}(\gamma,3\alpha)$ REACTION AT 17.6 MEV. Wilfrid Sébaoun and Henri Gauvin (Institut du Radium, Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). J. phys. radium, 22: 771-3(Nov. 1961). (In French)

The results obtained on the distribution of E^* in the study of the mechanism of $C^{12}(\gamma,3\alpha)$ at 17.6 Mev were analyzed by the hypothesis that the excited nucleus of C^{12} emits an α particle, followed by the decay of the residual nucleus of Be^8 into two alpha particles. (J.S.R.)

13982 COULOMB EXCITATION OF As^{75} Hiromichi Kamitsubo (Tokyo Univ.). J. Phys. Soc. Japan, 17: 253-60 (Feb. 1962). (In English)

Coulomb excitation of As^{75} was studied using protons and α particles at 2.1 to 2.8 and 3.0 to 3.8 Mev, respectively. Four levels of 199, 280, 574, and 810 kev were excited, and gamma transitions from these levels to the ground state were observed. The excitation functions and absolute cross sections of excitation were measured. The reduced transition probabilities were 0.012 ± 0.0025, 0.023 ± 0.005, 0.078 ± 0.015, and 0.044 ± 0.013 ($e^2 \times 10^{-48}$ cm^4) respectively. The angular distribution of 280-kev gamma was $1 - 0.182P_2(\cos\theta) + 0.0035P_4(\cos\theta)$. The anisotropies of 199, 574, and 810-kev gamma were 0.04 ± 0.04, 0.19 ± 0.02, and 0.00 ± 0.05, respectively. From these results, the spins and parities of four levels are found to be ½−, ⅝−, ⅝−, and ⅜− or ½−. E2 − M1 mixing parameters of 280 and 574-kev transitions are δ = 0.42 ± 0.05 and 2.4 ± 1.0 or 0.75 ± 0.15. No coincidence of gamma rays was found. (auth)

13983 MULTIPOLARITY OF COULOMB EXCITATION OF As^{75} AND Pt^{195} Atsuko Ito and Kazuo Ôno (Tokyo

Univ.). J. Phys. Soc. Japan, 17: 260-3(Feb. 1962). (In English)

In Coulomb excitation experiments the multipole order of the excitation process can be determined theoretically on the basis of the yield curves but the yield curves of E2 and E1 excitation are nearly parallel for large ξ values and it is difficult to distinguish E2 from E1 on the basis of the excitation function. To determine the multipolarity of the mode of excitations, thick target yield ratios were measured for the 200- and 280-kev states in As^{75} and the 210-kev state in Pt^{195} using protons and α particles. Each of the states was reached by an electric-quadrupole transition. (auth)

13984 DECAY OF Eu^{148}. Kazusuke Sugiyama (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 17: 264-73(Feb. 1962). (In English)

The level structure of Sm^{148}, which is near the neutron closed shell 82, was studied by analyses of radiations from the decay of Eu^{148} (54 days) with scintillation spectrometers. The single and the coincidence measurements were made by means of 3 in. × 3 in. and 2 in. × 2 in. NaI(Tl) crystals, and the 5 in. × 4 in. well type NaI(Tl) crystal was also used for searching the level population in the Sm^{148} nucleus. Spins of the levels were determined using the gamma-gamma directional correlation method. The following levels were proposed for Sm^{148}: 555(2+), 1183(4+), 1470(1), 1598(3), 1735(4+), 1911(3 or 4), 2148, 2220, 2460, 2500, 2740, 2830, 3100, and 3370 kev. Results are compared with predictions of models of even-even nuclei. (auth)

13985 ENERGY SPECTRA OF PHOTOPROTONS FROM P^{31} AND Ca^{40}. Katsufusa Shoda, Takeo Ishizuka, Nobuaki Kawamura, Ken Abe, and Motoharu Kimura (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 17: 401-2(Feb. 1962). (In English)

Photoproton spectra from P^{31} and Ca^{40} irradiated by 19 and 20.5-Mev bremsstrahlung, respectively, were observed using nuclear emulsions and previous methods (K. Shoda, et al., J. Phys. Soc. Japan, 16: 1807(1961)). Results were compared with the statistical model using the Weisskopf level density (V. F. Weisskopf and J. M. Blatt, Theoretical Nuclear Physics (John Wiley and Sons), 311(1954)). Data are presented in graphical form. (L.N.N.)

13986 ENERGY SPECTRUM OF PHOTOPROTONS FROM Al^{27}. Katsufusa Shoda (Tohoku Univ., Sendai), Takeo Ishizuka, Koichi Shimizu, and Makoto Akashi. J. Phys. Soc. Japan, 17: 407(Feb. 1962). (In English)

The energy spectrum of photoprotons from Al^{27}, induced by 24-Mev bremsstrahlung, was detected in emulsions using previous methods and apparatus (K. Shoda, et al., J. Phys. Soc. Japan, 16: 1807(1961)). Spectral types differ between odd and even Z nuclei. Data are presented in graphical form. (L.N.N.)

13987 THE DECAY SCHEME OF 10.1-h Am^{244}. S. E. Vandenbosch and P. Day (Argonne National Lab., Ill.). Nuclear Phys., 30: 177-90(Feb. 1962). (In English)

A 10.1-hr beta-emitter produced by neutron irradiation of enriched (99.97%) Am^{243} was chemically identified as an isotope of Am and is assigned to an isomer of Am^{244}. The decay scheme was studied using a beta spectrometer in addition to γ-γ and γ-β conicidence scintillation counting techniques. A single β group with an end point energy of 387 ± 1 kev (log ft = 5.7) populates a 1042-kev level in Cm^{244}. This 1042-kev level decays to the 4+, 6+, and 8+ members of the ground state rotational band by highly retarded E2 transitions suggesting that it is a (6,6+) particle level. Rotational levels were observed at 0(0,0+), 42.9(0,2+), 142.3(0,4+), 296(0,6+) and 502(0,8+) kev. The 26-min isomer of Am^{244} decays by beta emission principally to the ground state of Cm^{244} with an energy of 1498 ± 10 kev (log ft = 6.3). Spin assignments of 6− to the 10.1-hr ground state and 1− to the 26-min isomer were obtained by couplings of the odd neutron and odd proton Nilsson orbitals. These assignments are consistent with the data. (auth)

13988 ANGULAR DISTRIBUTION OF FAST PHOTONEUTRONS. G. C. Reinhardt and W. D. Whitehead (Univ. of Virginia, Charlottesville). Nuclear Phys., 30: 201-14 (Feb. 1962).

The angular distributions of photoneutrons with energies greater than the $Si^{28}(n,p)Al^{28}$ threshold were determined for Bi, Ho, Au, La, Pr, and Y irradiated with 55-Mev bremsstrahlung. The distributions are all peaked in the forward direction, and the angular distributions were fitted to $W(\theta) = \Sigma_{i=0}^{4} a_i \cos^i\theta$, using a least squares analysis. (auth)

13989 THE 721, 809, 839 AND 954 Kev RESONANCES OF THE $Mg^{26}(p,\gamma)$ REACTION. T. R. Ophel and B. T. Lawergren (Australian National Univ., Canberra). Nuclear Phys., 30: 215-26(Feb. 1962). (In English)

Gamma spectra and angular correlation measurements were obtained at the 721, 809, 839, and 954-kev resonances of the $Mg^{26}(p,\gamma)$ reaction. Spins have been assigned to the 809($\frac{3}{2}$), 839($\frac{1}{2}$), and 954($\frac{3}{2}$)-kev resonances. No assignment could be made to the 2.2-Mev level of Al^{27}. (auth)

13990 THE ENERGY LEVELS OF IODINE ISOTOPES IN THE UNIFIED MODEL. B. Banerjee and K. K. Gupta (Tata Inst. of Fundamental Research, Bombay). Nuclear Phys., 30: 227-31(Feb. 1962). (In English)

Energy levels of I^{127} and I^{129} isotopes are calculated on the basis of the unified model. Agreement with observed levels is obtained for I^{129}, but there are discrepancies in the case of I^{127}. (auth)

13991 THE FISSION NEUTRON SPECTRUM OF U^{235}. C. Beets and H. Deckers (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium). Nuclear Phys., 30: 232-8(Feb. 1962). (In English)

A measurement of the low energy part (0.28 to 1.8 Mev) of the fission neutron spectrum of U^{235} by means of Ilford L4 emulsion is described. The experimental arrangement allows the elimination of the depth measurements, which are a source of errors. The results fit a Maxwellian spectrum with energy parameter 1.20 ± 0.10 Mev. (auth)

13992 SPINS OF NEUTRON RESONANCES IN Pu^{239} FROM SCATTERING MEASUREMENTS. J. S. Fraser and R. B. Schwartz (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 30: 269-79(Feb. 1962). (In English)

Measurements of neutron scattering from the low energy resonances of Pu^{239} were performed using the Harwell 28-Mev linear electron accelerator as a pulsed neutron source. The scattering yield $\sigma_0\Gamma_n$ was measured for eight resonances, resulting in five assignments of spin J = 1 and three assignments of J = 0. The results support a multi-level analysis of the low energy neutron cross sections of Pu^{239}. The results are consistent with equal average fission widths and equal average radiation widths for the two spin states. (auth)

13993 NUCLEAR SPECTRA OF OXYGEN ISOTOPES. I. Talmi and I. Unna (Weizmann Inst. of Sciences, Rehovoth, Israel). Nuclear Phys., 30: 280-91(Feb. 1962). (In English)

The spectra of O^{17}, O^{18}, O^{19}, and O^{20} are considered in the

framework of the shell model. The low lying energy levels of these nuclei are found to be well described by jj-coupling configurations involving the $1d_{\frac{5}{2}}$ and $2s_{\frac{1}{2}}$ orbits. The predicted positions of other levels are discussed. (auth)

13994 THE HARMONIC OSCILLATOR CONSTANT IN p SHELL NUCLEI AND CHARGE DEPENDENCE OF NUCLEAR FORCES. S. Sengupta (Presidency Coll., Calcutta). Nuclear Phys., 30: 300-11(Feb. 1962). (In English)

In view of large fluctuations of the harmonic oscillator constant $\alpha = \sqrt{\omega M/\hbar}$ in the p shell region, the question of whether α remains a constant in isobaric nuclei is examined. From the analysis of the Coulomb energy data of even-mass nuclei, it is concluded that α is independent of the relative number of protons. As the indirect Coulomb effect on α is estimated as negligible, a small persistent variation of α by 2 to 3% is interpreted as showing a relative lowering of the $T_z = 0$ level of the isobaric triplet. This lowering Δ is estimated to have a mean value of 0.080 Mev. The effect can be understood in terms of an extra interaction between unlike particles, which yields 2.1% charge dependence in the singlet state. A symmetric pseudoscalar meson theory predicts a charge dependence of the two body nuclear interaction because of the mass difference between charged and neutral pions. Δ calculated from it differs widely in LS- and jj-coupling wave functions. Experimental values are mostly intermediate between these limits. Values of α were calculated for all mass numbers $5 \leqq A \leqq 15$ using complete neutron and proton wave functions in the LS-coupling shell model and compared with those obtained from electron scattering. (auth)

13995 POLARIZATION OF HIGH-ENERGY β-RAYS FROM B^{12}. P. Lipnik, J. P. Deutsch, L. Grenacs, and P. C. Macq (Université, Louvain, Belgium). Nuclear Phys., 30: 312-15(Feb. 1962). (In English)

The longitudinal polarization of B^{12} β was measured in the 7 to 13 Mev region. The polarization found is $P = -(v/c)(0.98 \pm 0.06)$. (auth)

13996 THE SPIN-ORBIT INTERACTION IN THE SCATTERING OF 147-220 Mev NUCLEONS BY LIGHT NUCLEI. B. A. Robson (Australian National Univ., Canberra). Nuclear Phys., 30: 316-27(Feb. 1962). (In English)

The polarizations and differential cross sections in the elastic scattering of 147 to 220 Mev nucleons by He^4, Li^7, C^{12}, and Al^{27} are examined using the optical model. The usual form of the nuclear potential $v(r) = -(V + iW)g(r) + (\gamma + i\delta)r^{-1}(dg/dr)\sigma \cdot L$, where g(r) is a Woods-Saxon form factor, is found to be inadequate for a detailed description of the observations especially for light nuclei. Taking a spin-orbit potential of the form $(\gamma' + i\delta')\{r^{-3}(d^2g/dr^2) + \epsilon' r^{-1}(dg/dr)\}\sigma \cdot L$ gives substantially better agreement with the data. It is shown how this modification of the Thomas-Fermi spin-orbit interaction may be related to higher order terms in the optical model expansion obtained in Born approximation from nucleon-nucleon scattering amplitudes. (auth)

13997 THE LOWEST T = 0 STATES IN THE ODD N = Z NUCLEI WITH A > 40. J. Jaenecke (Univ. of Michigan, Ann Arbor). Nuclear Phys., 30: 328-31(Feb. 1962). (In English)

There is indication that the lowest T = 0 and T = 1 states are inverted not only in Cl^{34} but also in Sc^{42}, V^{46}, Mn^{50}, and Co^{54}. Isomerism in all these nuclei is likely. (auth)

13998 COULOMB EXCITATION OF LEAD AND BISMUTH WITH 20 Mev α-PARTICLES. Ove Nathan (Univ. of Copenhagen). Nuclear Phys., 30: 332-46(Feb. 1962). (In English)

The γ-rays resulting from Coulomb excitation of Pb^{204}, Pb^{206}, Pb^{207}, and Bi^{209} were measured in coincidence with the backwards scattered projectiles. The experiment was performed with α particles accelerated to 20 Mev in a cyclotron. Reduced E2 transition probabilities were obtained from the thick target γ yields, and the errors which may be involved are discussed. For the single-particle transitions in Pb^{207} and Bi^{209}, the observed E2 transition rates were compared with the theoretical single-particle values calculated for the case of a diffuse nuclear potential. The results indicate an effective E2 neutron charge of $(0.85 \pm 0.20) \times e$ in Pb^{207} and an effective E2 proton charge $\lesssim 2.6e$ in Bi^{209}. The results for Pb^{204} and Pb^{206} were compared with the predictions of L. S. Kisslinger and R. A. Sorensen (Mat. Fys. Medd. Dan. Vid Selsk., 32: No. 9(1960)). The agreement is good if an effective E2 neutron charge of 1.0e is used. (auth)

13999 NEUTRON RESONANCE IN SAMARIUM. Austin Bernabei (Manhattan Coll., New York, N. Y.), L. B. Borst, and V. L. Sailor. Nuclear Sci. and Eng., 12: 63-7(Jan. 1962). (BNL-5369)

The total neutron cross section of Sm^{152} was measured in the energy range from 6.84 to 9.18 ev with the BNL crystal spectrometer using the Be (1231) crystal planes as a monochromator. The resonance at 8.036 ev was fitted to a Breit-Wigner single-level formula by the method of shape analysis. Since the target nucleus is even-even, I = 0, and hence the statistical weight factor g = 1. Consequently all Breit-Wigner parameters can be determined from the total cross section measurements alone. The resonance parameters obtained from the analysis are: $E_0 = 8.036 \pm 0.010$ ev, $\sigma_0 = 210{,}000 \pm 2000$ barns, $\Gamma = 0.201 \pm 0.008$ ev, $\Gamma_\gamma = 0.071 \pm 0.010$ ev, and $\Gamma_n = 0.130 \pm 0.005$ ev. (auth)

14000 FISSION-PRODUCT CAPTURE CROSS SECTIONS. J. D. Garrison and B. W. Roos (General Dynamics Corp., San Diego, Calif.). Nuclear Sci. and Eng., 12: 115-34(Jan. 1962).

Experimental measurements of fission product capture cross sections and statistical estimates of capture cross sections for energies at which no measurements have been made yielded a set of group cross sections for primary and secondary fission products covering the complete range of energies of interest for reactor calculations. Capture cross sections and fission product yield measurements were obtained from a comprehensive search covering published and some unpublished measurements available prior to May 1961. Unmeasured capture cross sections in the resonance region were statistically estimated using average neutron strength functions, level spacings, and radiation widths. The general techniques of obtaining reliable nuclear parameters and estimates of cross sections are discussed in detail. The importance of capture in short-lived fission products is considered. The group cross sections obtained in this work were combined and presented in a form useful for calculating fission product poisoning in reactors containing U^{233}, U^{235}, and/or Pu^{239}. Results are analyzed and compared with previously published fission product studies. (auth)

14001 SINGLE TRANSMISSION EFFECT FOR SLOW NEUTRONS PASSING THROUGH MAGNETIZED Pd–Ni ALLOY, CONTAINING ABSORBED HYDROGEN. N. Mitrofanov (Universidad, Chile, Santiago). Phys. Rev., 125: 1141-3(Feb. 15, 1962).

Results are reported on experiments in which a single-transmission effect was observed when passing thermal neutrons through magnetized Pd–Ni (46 at.% Ni) alloy containing absorbed hydrogen. A striking correlation was

found between the single-transmission effect and the amount of hydrogen in the alloy; when applying an external field of 5000 gauss, the maximum was 5.2 ± 0.9% with a total of 10 sheets. No single-transmission effect was observed with epithermal cadmium neutrons nor with Pd-Ni samples free of hydrogen. The results of polarization measurements with iron and nickel samples agree with the results reported in the literature. The observed decrease in the magnetic moment of Pd–Ni alloy with added hydrogen excludes common Bloch-type neutron polarization as a possible explanation of the effect mentioned. The phenomenon could be qualitatively understood on the assumption that protons are aligned in the magnetic field of the crystalline structure of the alloy. (auth)

14002 LOW-ENERGY SCATTERING OF A CHARGED PARTICLE BY A NEUTRAL POLARIZABLE SYSTEM. Thomas F. O'Malley, Leonard Rosenberg, and Larry Spruch (New York Univ., New York). Phys. Rev., 125: 1300-10(Feb. 15, 1962).

In the scattering of a particle (or system) of charge Ze by a neutral system with an electrical polarizability α, an electric dipole moment is induced which generates an effective potential that behaves asymptotically as $-\frac{1}{2}Z^2e^2\alpha/r^4$. Due to this effective long-range interaction, effective-range theory theory in its normal form is not applicable. Thus, for the scattering of a particle with an incident orbital angular momentum of zero, for example, the expansion of $k\cot\eta(0)$ includes terms in k and in $k^2\ln k$, in addition to the usual constant and k^2 terms. The effective range r_0 as normally defined is infinite, but one can define a quantity r_{p0} which explicitly takes into account the long-range character of the effective potential. For $L > 0$ it is $k^{2L}\cot\eta(L)$ which approaches a constant as k approaches zero rather than $k^{2L+1}\cot\eta(L)$ as for a short-range potential. The above results can have serious consequences in the scattering of electrons and of positrons by neutral spherically symmetric atoms. Some detailed consideration is given to the scattering by hydrogen atoms. The formulation of effective-range theory which is given is valid when Pauli exchange between the two colliding systems is possible. The method used for taking into account the effect of the Pauli principle (this method would be the same for long-range and short-range forces) is rather more convenient than in the usual presentation of effective range theory. (auth)

14003 ELECTRON TRIPLET PRODUCTION BY HIGH-ENERGY PHOTONS IN HYDROGEN. Duane C. Gates, Robert W. Kenney, and William P. Swanson (Univ. of California, Berkeley). Phys. Rev., 125: 1310-18(Feb. 15, 1962). (UCRL-9390(Rev.))

The 323-Mev hardened bremsstrahlung beam from the Berkeley synchrotron was used to produce electron-positron pairs and triplets in a 4-in.-dia. liquid hydrogen bubble chamber. It was found that the experimental triplet cross sections for detectable recoils (momentum greater than 0.27 Mev/c) and for recoils with momentum greater than mc rise logarithmically with photon energy to 100 Mev, then level off at approximately 2.8 mb and 1.5 mb, respectively. The total triplet cross section agrees with that of Borsellino above 20-Mev photon energy. No contribution due to exchange terms was found. The positron energy distribution agrees with that of Wheeler and Lamb. The recoil momentum distribution agrees substantially with that of Suh and Bethe. Approximately one event due to multiple pair production was expected, but none was found. (auth)

14004 NEUTRON-INDUCED FISSION OF Pu^{241}. H. L. Smith, R. K. Smith, and R. L. Henkel (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 125: 1329-33(Feb. 15, 1962).

The neutron-induced fission cross section for Pu^{241} was measured at neutron energies between 0.25 and 21 Mev. The fission excitation function is similar to other even-odd fissionable nuclei and shows a cross section of 1.68 ± 0.08 barns at 3 Mev. A rough correlation is developed from fission systematics which allows predictions of 3-Mev cross sections. U^{235} fission cross section values between 10 and 21 Mev (previously unpublished) are also tabulated. (auth)

14005 CROSS SECTIONS FOR THE $B^{11}(n,\gamma)B^{12}$ REACTION. W. L. Imhof, R. G. Johnson, F. J. Vaughn, and M. Walt (Lockheed Missiles and Space Co., Palo Alto, Calif.). Phys. Rev., 125: 1334-6(Feb. 15, 1962).

Cross sections for the reaction $B^{11}(n,\gamma)B^{12}$ were measured by an activation technique for neutron energies from 139 to 2325 kev and at thermal energy. Resonances in the reaction were observed at neutron energies of 430, 1030, 1280, and 1780 kev. Since the resonance at 1030 kev did not correspond to a known level in B^{12}, the total neutron cross section for boron was measured with 4-kev resolution in the neutron energy region between 950 and 1350 kev. An S wave resonance was observed in the total cross section at 1027 ± 10 kev. This resonance corresponds to a level in B^{12} at an excitation energy of 4.31 Mev; it most probably has spin and parity of 1^- and a width of 10 ± 4 kev. From an analysis of the capture cross section resonances, the radiation widths of the levels were found to be 0.3 ev at 430 kev, 0.3 ev at 1027 kev, 0.2 ev at 1280 kev, and 0.9 ev at 1780 kev, with estimated uncertainties of 50%. The measured value of the $B^{11}(n,\gamma)B^{12}$ cross section for thermal neutrons was 5 ± 3 mb. (auth)

14006 CONVERSION-ELECTRON ANGULAR CORRELATIONS FOR STRIPPING REACTIONS. Eugene V. Ivash (Univ. of Texas, Austin). Phys. Rev., 125: 1337-9(Feb. 15, 1962).

The (d,p;e) and (d,n;e) angular correlation between the outgoing proton or neutron of a stripping reaction and a possible internal conversion electron is theoretically investigated. Expressions for the correlation function similar to those for (d,p;γ) and (d,n;γ) angular correlations are obtained, differing only in the presence of the particle parameters $b_\nu(LL';e)$. It is suggested that conversion-electron correlations for stripping reactions may prove useful as a nuclear spectroscopic tool for the heavier nuclei. (auth)

14007 ALPHA PARTICLES FROM Be^9 AND C^{12} BY 25-Mev ALPHA-PARTICLE BOMBARDMENT. Lynn B. Brown and H. B. Knowles (Univ. of California, Livermore). Phys. Rev., 125: 1339-49(Feb. 15, 1962). (UCRL-6515)

Alpha-particle spectra from thin beryllium and carbon targets were taken at 47.5° laboratory angle and an alpha energy of 25.41 Mev. The center-of-mass spectra of both nuclei indicate that the four-body reactions $Be^9(\alpha;3\alpha,n)$ and $C^{12}(\alpha;4\alpha)$ are greatly preferred over the three-body reactions $Be^9(\alpha;\alpha,n)Be^8$ and $C^{12}(\alpha;2\alpha)Be^8$. Several inelastic levels of both nuclei appear, and the recoil-decay alpha particles from the 9.61-Mev level of C^{12*} are seen. The Fermi statistical model is invoked in an attempt to establish that the multibody reactions are reasonably representative of the proportions of the two- and three-cluster configurations in the ground states of the two nuclei, and that the three-cluster configurations are preferred. (auth)

14008 MOMENTUM TRANSFER IN HEAVY-ION-INDUCED FISSION. Torbjoern Sikkeland, Eldon L. Haines, and Victor E. Viola, Jr. (Univ. of California, Berkeley) Phys. Rev., 125: 1350-7(Feb. 15, 1962). (UCRL-9751)

The forward linear momentum transfer in reactions leading to fission between heavy ions such as C^{12}, N^{14}, O^{16}, and Ne^{20} and the target nuclei Ho, Au, Bi, and U^{238} was investigated by measuring the angular correlation between the fragments. The experimental values for the most probable parameters for center-of-mass transformation for these systems are compared with calculated values. For all the systems, the dominant reaction involves a full momentum transfer by the heavy ion to the fissioning nucleus. It is observed that for the system Au + Ne^{20} and Bi + Ne^{20}, reactions with incomplete momentum deposition contribute 5.1% and 8.6%, respectively, to the total fission cross section. For U^{238} targets, this admixture amounts to 12 to 17% for all ions at the highest bombarding energy and decreases with decreasing projectile energy. Possible reaction mechanisms leading to fission are suggested. A brief discussion of the method and its application is given. (auth)

14009 NUCLEAR STRUCTURE STUDIES IN THE ZIRCONIUM REGION WITH STRIPPING REACTIONS. Bernard L. Cohen (Univ. of Pittsburgh). Phys. Rev., 125: 1358-63(Feb. 15, 1962).

The single quasi-particle levels in Sr^{89}, Zr^{91}, Zr^{93}, Zr^{95}, and Zr^{97} are located and identified by (d,p) and (d,t) reaction studies. Values of occupation numbers (V_j^2) are determined both by location of levels and by cross section measurements (the two methods agree) and are used to estimate the unperturbed single-particle states in the shell-model potential. The $g_{9/2}$ state is found to be far above the $d_{5/2}$ (and even above the $s_{1/2}$ and $d_{3/2}$) in contrast to the situation in the tin isotopes and the usual theoretical estimates. The ground state of Zr^{97} is found to be $\frac{1}{2}^+$. (auth)

14010 INTERNAL BREMSSTRAHLUNG SPECTRUM ACCOMPANYING 1S ELECTRON CAPTURE IN DECAY OF Fe^{55}, Cs^{131}, AND Tl^{204}. M. H. Biavati, S. J. Nassiff, and C. S. Wu (Columbia Univ., New York). Phys. Rev., 125: 1364-72(Feb. 15, 1962).

The internal bremsstrahlung spectra in coincidence with the K x rays resulting from 1S electron capture in Fe^{55} and Cs^{131} were measured. The results are in good agreement with Martin and Glauber's revised calculations including relativistic and screening effects. The shape of the coincidence spectra exhibits a maximum at the predicted energy and then drops off in intensity toward the low-energy region. This is markedly different from that of the total bremsstrahlung spectrum, which rises continuously toward the low-energy region. In the case of Cs^{131}, the shape of the bremsstrahlung spectrum pertaining to the radiative capture of P electrons as obtained by subtracting from the total spectrum the spectrum due to S-electron capture is also in good accord with that predicted. An estimate of the total probability for bremsstrahlung production during 1S electron capture as obtained by comparing the corresponding bremsstrahlung spectrum with the x-ray intensity gives $1.5 \pm 0.8 \times 10^{-5}$ for Fe^{55} and $1.4 \pm 1 \times 10^{-5}$ for Cs^{131}, which is in fair agreement with the theoretical prediction including relativistic corrections. The end point of the 1S electron capture bremsstrahlung spectrum of Tl^{204} was also measured and found to be 310 ± 10 kev. (auth)

14011 COULOMB EXCITATION OF LEVELS IN Se^{77}. R. L. Robinson, F. K. McGowan, and P. H. Stelson (Oak Ridge National Lab., Tenn.). Phys. Rev., 125: 1373-8 (Feb. 15, 1962).

An investigation was made of the gamma rays which deexcite levels of Se^{77} that have been Coulomb excited by means of variable-energy alpha particles (2.1 to 8.0 Mev). The energies (in kev), spins and parities, and $B(E2)_{ex}$'s (in units of e^2 cm$^4 \times 10^{-50}$) found for the levels are: 242 ± 2, $\frac{3}{2}-$, and 18.2 ± 1.6; 248 ± 5, $\frac{5}{2}-$, and 0.37 ± 0.09; 440 ± 4, $\frac{5}{2}-$, and 25.9 ± 1.7; and 515 ± 8, $\frac{3}{2}-$, and 1.0 ± 0.2. New evidence for the two close-lying levels at 242 and 248 kev was provided by coincidence studies. A comparison of the $B(E2)_{ex}$'s to the $B(E2)_{sp}$ suggests that the 242- and 440-kev levels result from collective excitations of the ground-state configuration, and that the 248- and 515-kev levels result from changes in the ground-state configuration. Besides the ground-state transitions from these Coulomb-excited levels, gamma rays with energies of 87, 161, 203, and 283 kev were observed. Excitation curves of the 87- and 161-kev transitions indicate that they cascade from the 248-kev level. From the measurements of the gamma-ray angular distributions, values for $(E2/M1)^{\frac{1}{2}}$ of 0.18 ± 0.03 and 0.05 ± 0.03 were obtained, respectively, for the 242-kev gamma ray and for the 203-kev gamma ray, which originates at the 440-kev level. (auth)

14012 SIMPLE NUCLEAR REACTIONS OF Ga^{69} AND Ga^{71} WITH HIGH-ENERGY PROTONS. Norbert T. Porile (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 125: 1379-85(Feb. 15, 1962). (BNL-5706)

Excitation functions in the energy range of 0.5 to 2.9 Bev were measured for several (p,xn), (p,pxn), and (p,3pxn) reactions of Ga^{69} and Ga^{71}. The cross section for the (p,pn) reactions are about 57 mb at 2.9 Bev and 69 mb at 0.5 Bev. The cross sections for the (p,pxn) reactions decrease monotonically as x increases and are some 30–250 times larger than the isobaric (p,xn) reaction cross sections. The results are compared with Monte Carlo cascade and evaporation calculations. Good agreement is obtained at 0.5 Bev except in the case of the (p,pn) reaction. In the Bev region the agreement is less widespread. The (p,pn) cross sections are compared with a calculation that takes the effects of shell structure and a diffuse nuclear surface into account. Some preliminary conclusions about the availability of the $1f_{5/2}$ shell for (p,pn) reactions in this mass region are drawn on the basis of this comparison. (auth)

14013 PROTON-PROTON COLLISIONS AT 4.2 Bev. M. H. Blue, J. J. Lord, J. G. Parks, and C. H. Tsao (Univ. of Washington, Seattle). Phys. Rev., 125: 1386-93(Feb. 15, 1962).

Interactions between 4.15-Bev protons and the free hydrogen nuclei in nuclear emulsion are examined. The total elastic cross section from 27 events was determined to be 11.0 ± 2.6 mb. On the basis of 113 interactions, the total inelastic cross section was found to be 28.1 ± 3.1 mb. The partial cross sections corresponding to inelastic collisions having two, four, six, and eight secondary particles were found to be respectively 16.3 ± 2.4, 11.5 ± 1.8, 0.2 ± 0.1, and 0.1 ± 0.1 mb. While the total inelastic cross section varies slowly with energy, the partial inelastic cross sections were found to be strongly energy dependent. The observed angular distribution of elastically scattered protons in the center-of-mass system was sharply peaked in the forward and backward directions, in fair agreement with calculations based on a simple optical model applicable for energies between 2 and 10 Bev. Particles produced in inelastic collisions were identified as pions or protons by measurements of energy loss and multiple scattering. For those particles identified, center-of-mass system distributions of energy, angle, and transverse momentum are presented. (auth)

14014 VECTOR MESONS AND NUCLEON-NUCLEON POTENTIALS. R. S. McKean, Jr. (Univ. of Washington, Seattle). Phys. Rev., 125: 1399-1401(Feb. 15, 1962).

The role of the π-π resonances in the nucleon-nucleon force is considered on a model which treats these reso-

nances as particle exchanges. The nucleon form factors are used to obtain the resonance parameters; thus the coupling constant of the "particles" to the nucleon are the only free parameters. It is found that the qualitative features of the central, spin-orbit, and tensor potentials in all states can be reproduced, except that the central repulsive core has too long a range. These results suggest that π-π effects dominate rather than supplement the usual uncorrelated 2π, 3π contribution to the nucleon-nucleon force. (auth)

14015 RENORMALIZATION OF MANY-FERMION MOMENTUM-SPACE DISTRIBUTIONS IN HIGHER RANDOM PHASE APPROXIMATIONS. N. R. Werthamer and H. Suhl (Univ. of California, San Diego, La Jolla). Phys. Rev., 125: 1402-6(Feb. 15, 1962).

The approach to the many-fermion problem known as the method of higher random phase approximations (RPA) is given a more rigorous formulation. It is shown that the previous heuristic procedures for evaluation of the second RPA are justified, in that expectation values of plane wave operators with respect to the true ground state may validly be replaced by their values in the unperturbed Fermi state. This property of momentum-space occupation renormalization is conjectured to hold also to higher orders of RPA than the second. (auth)

14016 MINIMUM PRINCIPLE FOR MULTI-CHANNEL SCATTERING. Leonard Rosenberg and Larry Spruch (New York Univ., New York). Phys. Rev., 125: 1407-14(Feb. 15, 1962).

The usual variational principles of scattering theory are simply stationary principles. In a recent series of papers, all restricted to single-channel scattering, conditions have been established under which variational principles can be found which are much more powerful in that the functional that represents the variational estimate is not simply stationary in the neighborhood of the exact scattering solution but is rather an extremum. A lower bound has been obtained on the single real parameter, $\tan\eta_c$, which characterizes the scattering in the (uncoupled) channel c. The conditions previously established allowed for composite bound states, for the Pauli principle, for arbitrary angular momenta, and for long-range and in particular Coulomb potentials; at nonzero energies, the various potentials had to be truncated. The present paper deals with the extension to multi-channel scattering in which each of the open channels contains only two systems. The bounds are now on linear combinations of the elements of the reactance matrix or of the derivative matrix. The potentials must be truncated in a fashion very similar to that used in Wigner-Eisenbud theory. (auth)

14017 COHERENT PHOTOPRODUCTION OF π^0 FROM DEUTERIUM. Fokion T. Hadjioannou (Stanford Univ., Calif.). Phys. Rev., 125: 1414-21(Feb. 15, 1962).

The calculation of elastic photoproduction of π^0 mesons from deuterium, $\gamma + d \rightarrow \pi^0 + d$, is carried out in the impulse approximation at photon energies around 500 Mev. The single nucleon photoproduction amplitudes are taken from dispersion formulas and are corrected for kinematic effects due to internal momentum of the nucleons in the deuteron. The D-state part of the deuteron wave function is included and different models with Yukawa type or repulsive core wave functions are used. Formulas connecting the cross section with the deuteron form factors are given. For small momentum transfers, the formulas are of course model independent and reduce to the usual ones. The presence of a 7% D state in a repulsive-core model leads to a cross section which falls typically more slowly at high momentum transfers, e.g., at a momentum transfer 2.74 f^{-1}, the cross section is larger by about 40% than the cross section calculated in the absence of the D state. The experimental points favor this model. (auth)

14018 RUNAWAY MODES IN MODEL FIELD THEORIES. Sidney Coleman (California Inst. of Tech., Pasadena) and Richard E. Norton. Phys. Rev., 125: 1422-8(Feb. 15, 1962).

Within the framework of linear quantum field theories, a general study is presented of the existence and removal of runaway modes — solutions of the equations of motion which exhibit a real exponential time dependence. It is hoped that this work will yield insight into the corresponding problem in physically realistic theories. It is shown that runaway modes occur only when the Hamiltonian is not positive definite, and that they occur in linear quantum theories whenever they appear in the corresponding classical theories. Three methods are proposed for eliminating these unphysical modes. One is the analog of the method used by Dirac in classical electron theory; the other two are believed to be new. (auth)

14019 LOW-ENERGY PROTON PRODUCTION BY 160-Mev PROTONS. Raymond Fox and Norman F. Ramsey (Harvard Univ., Cambridge, Mass.). Phys. Rev., 125: 1609-14(Mar. 1, 1962).

Energy and angular distributions of emitted protons in the energy range 5 to 23 Mev from lead, tantalum, tin, and zinc when bombarded by 160-Mev protons were obtained. A peak was obtained in each of the energy distributions slightly below the Coulomb barrier of each element. The magnitude of the peaks increased with a decrease in the Coulomb barrier of the element. The angular dependence of the heights of the peaks for all of the elements was approximately isotropic. The angular distributions of the emitted protons with energies above the Coulomb barrier increased in the forward direction. (auth)

14020 ISOMERIC TRANSITION IN Sb^{122}. E. der Mateosian and M. L. Sehgal (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 125: 1615-18(Mar. 1, 1962). (BNL-5705)

An investigation of two gamma radiations (61 kev and 75 kev) of Sb^{122m} (3.5 min) reveal that the 75-kev transition has a K conversion coefficient that agrees with that of an E2 transition but a half life in agreement with that of an L = 3 transition. Delayed coincidence measurements disclose a state with a 1.8-μsec half life, which is populated by the 75-kev transition. This decays through the emission of a 61-kev gamma ray. This transition exhibits a K conversion coefficient in agreement with that of an E1 transition although the lifetime is more compatible with an L = 2 assignment. These transitions are delayed by factors of $\geq 10^6$. (auth)

14021 HALF-LIFE OF NICKEL-63. Donald L. Horrocks and A. Lee Harkness (Argonne National Lab., Ill.). Phys. Rev., 125: 1619-20(Mar. 1, 1962).

The half-life of Ni^{63} was calculated to be 91.6 ± 3.1 years from specific activity measurements. Liquid scintillation counting techniques were used to measure the disintegration rate. (auth)

14022 INTERPRETATION OF EXPERIMENTS ON THE BETA DECAY OF Eu^{152}. Harry Dulaney, C. H. Braden, and L. D. Wyly (Georgia Inst. of Tech., Atlanta). Phys. Rev., 125: 1620-4(Mar. 1, 1962).

The 1483-kev beta decay of Eu^{152} is considered using complete theoretical expressions and including the effect of the beta-circularly polarized gamma correlation along with the beta-gamma directional correlation and the beta

spectral shape. The data indicate that the nuclear matrix element parameter ξ_1 lies between 0.5 and 1. For some suitable sets of matrix element parameters the quantities u and x are small in qualitative agreement with the "modified B_{ij}" approximation. However, other suitable sets of matrix element parameters may be found which are in disagreement with the approximation. The method of analysis is generally applicable to first-forbidden beta decays with spin change 1, and the results from various types of experiments may be incorporated. (auth)

14023 INELASTIC SCATTERING BY DEFORMED NUCLEI. J. S. Blair, D. Sharp, and L. Wilets (Univ. of Washington, Seattle). Phys. Rev., 125: 1625-38(Mar. 1, 1962).

The techniques of the sharp and rounded cutoff models for elastic scattering are extended to the calculation of nuclear monopole and quadrupole excitation in the adiabatic approximation. In the case of scattering from nuclei with quadrupole deformations, a spheroidal coordinate system is introduced in which one of the coordinate ellipsoids coincides with the nuclear surface; the wave equation separates outside the range of the nuclear potential. Formal expressions and results of numerical calculations for the cross sections are presented for a case in which simple assumptions are made about the functional form of the partial wave amplitudes and where only terms linear in nuclear deformation are retained. One limit of the form for the spherical partial wave amplitudes leads to a sharp-cutoff model that goes over into the Fraunhofer results for moderate and large values of the critical angular momentum. It is found that graphs of the excitation cross section (and to a lesser extent the elastic scattering cross section) fall into a single-parameter family of "universal curves" when plotted against (scattering angles) × (critical angular momentum + ½). The single parameter is (thickness of transition region in l space) ÷ (critical angular momentum). The model is capable of reproducing the qualitative results of alpha-particle scattering at energies well above the Coulomb barrier. (auth)

14024 MOMENTUM DISTRIBUTIONS FOR PROTONS IN Li^6 IN THE CLUSTER MODEL. J. Strnad (Univ. of Ljubljana, Yugoslavia and J. Stefan Inst., Ljubljana, Yugoslavia). Phys. Rev., 125: 1639-41(Mar. 1, 1962).

The momentum distributions for protons with two different binding energies as measured in quasi-elastic scattering of Li^6 are calculated in a simplified cluster model. It is assumed that clusters in nuclei are well separated, and cluster-model wave functions which are not antisymmetrized are used. With cluster-model wave functions, experimental data from quasi-elastic scattering of protons on Li^6 can be reproduced, whereas this cannot be achieved with the simple shell model. (auth)

14025 DECAY OF Pm^{148}, Pm^{148m}, AND Eu^{148}. C. F. Schwerdtfeger, E. G. Funk, Jr., and J. W. Mihelich (Univ. of Notre Dame, Ind.). Phys. Rev., 125: 1641-9(Mar. 1, 1962).

The beta decay of Pm^{148} and Pm^{148m} (5.0 and 45.5 days) and electron capture by Eu^{148} (58 days) proceed to levels in Sm^{148}. These activities are investigated with scintillation and magnetic spectrometers, and coincidence and directional correlation techniques. Pm^{148} decays via three beta branches to levels at 1460 and 551 kev and the ground state, with the available energy being 2460 ± 20 kev. The decay of Pm^{148} and Eu^{148} each populate levels of 551, 1181, 1596, 1908, and 2098 kev. The long-lived Pm populates additional levels at 2027 and 2197 kev, and Eu^{148} populates levels at 1886, 2148, 2201, 2697(?), and 2780 kev. The experimental data are consistent with the 45-day state being approximately 140 kev above the 5-day state. Decay schemes consistent with the experimental data are presented. (auth)

14026 SPIN AND PARITY ASSIGNMENTS TO THE 5.63-Mev AND 5.80-Mev LEVELS OF Ne^{20}. J. A. Kuehner (Chalk River Labs., Chalk River, Ont.). Phys. Rev., 125: 1650-5(Mar. 1, 1962).

Angular correlations are measured, involving spin-zero particles in a special counter arrangement, which lead to the assignment of spins and parities to the 5.63- and 5.80-Mev states of Ne^{20}; assignments are made of 3− and 1− respectively. These are the lowest levels above the alpha-particle binding energy whose spin and parity allow formation by alpha-particle capture on O^{16}. A possible role of one or both of these levels in Ne^{20} formation in stars is discussed. The properties of these levels together with those of other levels in Ne^{20} suggest rotational band structure in Ne^{20}. (auth)

14027 EXACT NUMERICAL SOLUTION OF A THREE-BODY GROUND-STATE PROBLEM. George A. Baker, Jr., J. L. Gammel, B. J. Hill, and John G. Wills (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 125: 1754-8(Mar. 1, 1962).

The appropriate Schrödinger equation is solved numerically to give the wave function for the ground-state H^3 problem. An ordinary, Gaussian, two-body force without a hard core is used. It is shown how the method can be applied (including the Pauli exclusion principle) to the zero-energy scattering problem. (auth)

14028 NUMERICAL CALCULATIONS OF DIRECT INTERACTION CROSS-SECTIONS FOR (n,np) PROCESSES. S. B. Hyder (Osmania Univ., Hyderabad, India). Physica, 27: 1113-18(Dec. 1961). (In English)

Cross sections for (n,np) processes in Se, W, Ce, and Pd are numerically calculated, on the basis of direct interaction theory. Cross sections at different excitations of the residual nucleus are also calculated and are shown to have a sharp peak toward lower excitations. (auth)

14029 ON THE DECAY OF ^{102}Rh. P. Born, C. Bobeldijk, H. M. W. Booy, and J. Blok (Vrije Universiteit, Amsterdam). Physica, 27: 1229-38(Dec. 1961). (In English)

The beta and gamma radiation following the decay of Rh^{102} was investigated using a double-focusing beta spectrometer, single NaI(Tl) crystal, coincidence- and sum-coincidence gamma spectrometer. Gamma at 0.475, 0.628, 0.631, 0.700, 0.765, 1.050, 1.105, 1.115, 1.365, 1.565, 1.790, 2.040, and 2.265 Mev were found. A level scheme for Ru^{102} is proposed. (auth)

14030 ON THE LEVEL STRUCTURE OF ^{96}Mo. S. Monaro, G. B. Vingiani, and R. Van Lieshout (Instituut voor Kernphysisch Onderzoek, Amsterdam). Physica, 28: 52-62(Jan. 1962). (In English)

The level structure of Mo^{96} was studied through the decay of 4.3 ± 0.1-day Tc^{96} and of 23.5 ± 0.5-hour Nb^{96}. Only the 770-kev transition from the first excited state and the 840-kev stop-over gamma ray from the second excited state seem to be common to these two decays. Three additional higher excited states are populated from Tc^{96} and four different ones from Nb^{96}. Experimental results are cumulated in a tentative decay scheme, the main features being in agreement with those proposed in earlier studies. (auth)

14031 A NEW TECHNETIUM ACTIVITY: 4.5 HOUR $^{94}Tc^{m}$. S. Monaro, G. B. Vingiani, R. A. Ricci, and R. Van Lieshout (Instituut voor Kernphysisch Onderzoek, Amsterdam). Physica, 28: 63-9(Jan. 1962). (In English)

A 4.5 ± 0.2 hr technetium activity was produced by bombarding Mo, enriched in Mo^{94}, with 16-Mev deuterons. It decays by a 1000 ± 50-kev positron branch to a level at 2440-kev in Mo^{94}, which then emits a cascade of 860, 710, and 870-kev γ. Comparison with the decay of 52-min Tc^{94}, which takes place by positron emission (2.41-Mev), accompanied by γ at 870, 1530, 1870, 2410, 2730, and 3200 kev, makes the assignment of the 4.5-hr activity to Mo^{94} unambiguous. (auth)

14032 A DIRECT MEASUREMENT OF THE PROTON TOTAL REACTION CROSS SECTION FOR COPPER AT 9.3 Mev. G. W. Greenlees and O. N. Jarvis (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), 78: 1275-84 (Dec. 15, 1961).

A value of 930 ± 70 mb was obtained for the proton total reaction cross section for copper at 9.3 ± 0.3 Mev by a poor-geometry transmission method not involving counter coincidence techniques. This result, which is in good agreement with values obtained by indirect methods, is higher than values predicted by published optical model analyses using a volume absorption term. Differential elastic cross sections are presented for the angular range 30 to 155° (center of mass). These were obtained using the same target as in the reaction cross section measurement. Agreement with both the differential cross sections and the reaction cross section can be obtained using an optical model potential with an absorptive term peaked at the nuclear surface. (auth)

14033 PROTON SCATTERING BY COPPER AT 10 Mev. B. R. Easlea (Univ. of Copenhagen). Proc. Phys. Soc. (London), 78: 1285-96(Dec. 15, 1961).

An optical model analysis is given of the experimental data of N. M. Hintz at 9.75 Mev (Phys. Rev., 106: 1201 (1957)) and of G. W. Greenlees et al., at 9.30 and 9.47 Mev (Proc. Roy. Soc., 78: 1275(1961)); (Proc. Roy. Soc. A, 243: 206(1957)) on proton scattering by natural copper. A sufficiently general form factor for the imaginary part W of the optical potential is used such that W can have a maximum value lying in any desired region of the nucleus. It is found that the absorption must be peaked at the surface of the nucleus to fit not only the polarization and differential elastic cross section, but to give the correct magnitude of the total reaction cross section. Available experimental data do not allow determination of absorption occurring at the center of the nucleus or whether the maximum of W should lie slightly beyond the half-way radius of the real part of the optical potential. (auth)

14034 ON THE REACTION Pt(n,α)Os. M. W. Cresswell and R. R. Roy (Pennsylvania State Univ., University Park). Proc. Phys. Soc. (London), 78: 1297-1300(Dec. 15, 1961).

The reaction Pt(n,α)Os was investigated by a nuclear emulsion technique, using the thermal neutron flux of the Penn. State Univ. reactor. A semi-empirical range-energy relationship was developed for α particles in platinum and was used for the data evaluation. Two groups of alpha particles were observed with certainty, corresponding to Q-values 6.9 ± 0.3 and 8.5 ± 0.3 Mev, and were identified with reactions $Pt^{194}(n,\alpha)Os^{191}$ and $Pt^{195}(n,\alpha)Os^{192}$ respectively. A probable group of α particles corresponding to Q-value 12.1 ± 0.3 was associated with the reaction $Pt^{193}(n,\alpha)Os^{190}$. (auth)

14035 CENTER-OF-MASS CORRECTIONS IN NUCLEAR REACTION EXPERIMENTS. Henry Lorenzi and Bernard L. Cohen (Univ. of Pittsburgh). Rev. Sci. Instr., 33: 278-82(Mar. 1962).

In nuclear reaction experiments with heavy target nuclei, corrections for center-of-mass motion may be simplified by various approximations. Several methods of applying these corrections with varying accuracy and ease of computation are discussed. One of these involves a short hand computation using tables; another involves the use of curves which give very accurate results in a few seconds of hand calculation. (auth)

14036 EXPERIMENTAL EVIDENCE FOR ANOMALOUS BETA-GAMMA DIRECTIONAL CORRELATION IN Au^{198}. M. S. El-Nesr, Ekbal Bashandy, T. R. Gerholm, and T. Lindqvist (Univ. of Uppsala). Z. Physik, 166: 119-21 (1962). (In English)

Some anomalies in the longitudinal polarization and the beta shape of the nonunique first forbidden beta decay from Au^{198} initiated this careful experiment on the beta-gamma directional correlation of the same decay. The authors found evidence that the differential beta-gamma directional correlation also shows an anomalous behavior at beta energies below 200 kev. The anisotropy of the 0.96 Mev beta to 0.411 Mev gamma cascade at low energies, instead of decreasing with decreasing beta energy, is increasing sharply below 200 kev beta energy. Instrumental effects can be excluded as demonstrated with allowed transitions, which show the expected behavior in the same energy region. (auth)

14037 THE RELATIVE ISOTOPIC SITE OF Os^{184}. G. Noeldeke and G. D. Saksena (Universität, Heidelberg). Z. Physik, 166: 216-19(1962). (In German)

Using 3 mg of an osmium sample, enriched in Os^{184} to 2.25%, the isotopic shift $\Delta\nu(Os^{192}-Os^{184})$ was measured in two Os I lines with a recording Fabry-Perot interferometer. The relative isotopic shift of Os^{184} was found to be $\Delta\nu(Os^{192}-Os^{184})/\Delta\nu(Os^{192}-Os^{190}) = 4.79 \pm 0.05$. (auth)

14038 MEASUREMENT OF THE LONGITUDINAL POLARIZATION OF BETA RAYS FROM RaE (Bi^{210}) AND Sb^{124} WITH THE HELP OF MØLLER SCATTERING. D. M. Harmsen and K. Holm (Universität, Hamburg). Z. Physik, 166: 227-42(1962). (In German)

The electron-electron (Møller) scattering method is used for the determination of the helicity of beta rays from the 1.17 Mev transition of RaE and from the 2.31 Mev transition of Sb^{124}. The apparatus is described, and the evaluation of the efficiency of polarization detection for this apparatus is given in detail. The depolarization corrections are discussed. The results of the helicity measurements are $P = -(0.77 \pm 0.09)$ v/c for RaE at a mean energy of 640 kev and $P = -(0.90 \pm 0.14)$ v/c for Sb^{124} at a mean energy of 1550 kev. (auth)

14039 MEASUREMENT OF THE UNDISTURBED ANGULAR CORRELATION OF SUCCESSIVE NUCLEAR RADIATIONS IN THIN EVAPORATED LAYERS. H. Kaiser (Kernphysikalische Institut der Deutschen Akademie der Wissenshaften, Berlin). Z. Physik, 166: 355-8(1962). (In German)

It is shown that the nuclear quadrupole reciprocal effects of excited nuclear states with the electric field gradients in thin metal layers of cubic crystal structure disappear if the concentration of the dissolved atoms in the carrier is small. By means of incorporation of indium in lead layers with a thickness of 5×10^{-5} to 3×10^{-4} cm, the undisturbed angular correlation of In^{111} could be found. The measured anisotropy $A = -(0.23 \pm 0.012)$ agreed with the value found in the liquid source. (tr-auth)

14040 NEUTRON TIME-OF-FLIGHT METHODS. Proceedings of a Symposium Organized by European-

American Nuclear Data Committee in Collaboration with Centre d'Etudes Nucleaires de Saclay (France) and Institut National des Sciences et Techniques Nucleaires, Saclay, 24-27 July, 1961. J. Spaepen, ed. (European Atomic Energy Community). Sept. 1961. 601p.

Separate abstracts were prepared for 63 of the 65 papers included. Two were previously abstracted in NSA. (L.N.N.)

14041 GENERAL SURVEY ON TIME-OF-FLIGHT MEASUREMENTS APPLIED TO NUCLEAR PHYSICS. J. A. Harvey (Oak Ridge National Lab., Tenn.). p.23-56 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Large quantities of data exist on parameters of resonances from low energy neutron spectroscopy. Nuclear models were proposed to interpret average properties of levels such as D, Γ_n^0/D, etc. The distributions of the widths of the levels, Γ_n^0, Γ_γ, Γ_f, etc. are discussed. Weak correlations between certain parameters may occur, and there appears to be a striking anti-correlation between partial radiation widths. (auth)

14042 GENERAL SURVEY ON TIME-OF-FLIGHT MEASUREMENTS IN THE STUDY OF NUCLEAR REACTOR PARAMETERS. C. H. Westcott (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.57-67 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Requirements for measurements made by the time-of-flight technique to provide data for nuclear reactor design fall mainly within the following six categories: (a) spectra within lattice assemblies; (b) accurate values of data for fissile isotopes, both σ_{2200} and $\sigma(E)$ for fission and capture, as well as ν, η, α; (c) data for absorption in fission products; (d) data for absorption, and scattering data for structural materials; (e) for fast reactors, scattering data generally including $\sigma(E,E')$ and $\sigma(E,E',\theta)$; and (f) thermal region $\sigma(E,E')$ and $\sigma(E,E',\theta)$ data. These requirements are discussed with particular reference to the accuracy desired. Consideration is given to the consequences of modern multichannel analyzer techniques. (auth)

14043 GENERAL DISCUSSION OF TIME-OF-FLIGHT MEASUREMENTS IN SOLID AND LIQUID STATE PHYSICS. P. A. Egelstaff (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.69-74 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Neutron time-of-flight measurements form the basis of many experiments in the solid and liquid state fields. Their usefulness in these fields is considered with respect to future requirements. Schematic examples of results are discussed. (auth)

14044 GENERAL SURVEY ON TOTAL AND SCATTERING CROSS SECTION TECHNIQUES. R. G. Fluharty (Phillips Petroleum Co., Idaho Falls). p.77-83 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Although time-of-flight instruments have high resolutions, total and scattering cross section experiments are difficult for cases where $\Gamma_n \ll \Gamma$ and the level spacing is small. For these cases the fast choppers will continue to be competitive with the accelerators in nuclear systematics, especially for small samples of rare isotopes. There is a limit to the number of available levels, even for high resolution machines due to the motion of the target nuclei and, as a consequence, a limit to the accuracy that can be obtained on average parameters. It is suggested that gains can be made by using low-temperature samples and that precision improvements of a factor of ten be incorporated. To handle the analysis of the large number of levels, routine machine analysis methods are used. For the larger spacing-large scattering cases, experiments can be performed. It is suggested that simultaneous measurements will be made upon total and partial cross sections. (auth)

14045 CROSS SECTION MEASUREMENTS ON RADIOACTIVE SAMPLES. F. B. Simpson and R. P. Schuman (Phillips Petroleum Co., Idaho Falls). p.85-91 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A shielded automatic sample changer was incorporated with the Materials Testing Reactor (MTR) fast chopper to facilitate cross section measurements on radioactive samples. The sample changer holds a maximum of four samples which may be cycled automatically and selectively in and out of the neutron beam. The shielding was designed for 1.8×10^{14} 1-Mev γ rays per second. Preliminary measurements of the total cross sections of Au^{198} and Pa^{233} were made. An approximately 500-curie Au^{198} sample was produced by irradiating Au^{197} in the MTR. The thickness of the gold sample was approximately 68000 b/atom Au^{198}. The total cross section was investigated between 0.01 and 1 ev. The Pa^{233} sample was produced by the irradiation of Th^{232} in the Engineering Testing Reactor (ETR), and contained approximately 650 curies of Pa^{233}. When measurements were started, the irradiated thorium sample had a thickness of approximately 4300 b/atom of Pa^{233} and 10000 b/atom of U^{233}. The total cross section was investigated from 0.02 to 10 ev, and preliminary parameters were determined for the resonances observed. (auth)

14046 HIGH RESOLUTION TIME-OF-FLIGHT SPECTROSCOPY OF NEUTRONS OF INTERMEDIATE ENERGY. C. Corge, V. D. Huynh, J. Julien, J. Morgenstern, and F. Netter (Centre d'Etudes Nucléaires, Saclay, France). p.93-5 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Experiments on U^{238} were performed in the Saclay linear accelerator using the time-of-flight method for neutrons at 1 to 3.5 kev. Resolution as high as 1 nanosec/m was reached. Other experiments with 2.5 nanosec/m resolution showed new resonances in As, Zr, and Pr. (auth)

14047 HIGH RESOLUTION TOTAL CROSS SECTION MEASUREMENTS. P. Ribon, A. Michaudon, J. Girard, and J. Labaye (Centre d'Etudes Nucléaires, Saclay, France). p.97-103 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The equipment of a flight path devoted to total cross section measurements is described; it includes a B^{10} capture γ detector together with characteristic features. The aim was to obtain a good over-all geometry, a large detector surface, and a low background. The counting rate at 100 m, for a 100 cm^2 sample area is 14000 counts/hour per $(\mu s)^2$ at 1 kev and 250 pps. The over-all background is about 4%. A transmission measurement carried out on Rh with a resolution of 2.3 nanosec/m is described. (auth)

14048 NEUTRON TRANSMISSION MEASUREMENTS WITH LOW TEMPERATURE SAMPLES. C. Le Pipec, A. Michaudon, P. Ribon, and E. Olivier (Centre d'Etudes Nucléaires, Saclay, France). p.105-7 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Whatever the resolution of a time-of-flight installation, the experimental study of resonances meets a difficulty arising from the Doppler effect. When resonances are resolved, evaluation of the parameters takes account of the Doppler effect by using the results of Bethe and Lamb.

It was shown that, under certain conditions, the nuclei of a crystal can be considered as a gas to which an effective temperature can be assigned; this is generally determined on the basis of the Debye model. A cryostat was constructed to reduce this Doppler effect, or to improve knowledge of it. A considerable deformation of the ray develops when its natural width is sufficiently small and the Debye crystal temperature sufficiently high. The cryostat enables studies of such resonances as a function of temperature. The cryostat is described and results shown. (auth)

14049 TOTAL CROSS SECTION OF Th^{232} BETWEEN 300 eV AND 60 keV. C. A. Uttley and R. H. Jones (Atomic Energy Research Establishment, Harwell, Berks, England). p.109-14 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The neutron total cross section of Th was measured by the transmission method between 0.3 and 60 kev at 1.6 nanosec/m resolution using the neutron booster time-of-flight spectrometer. Parameters of about 50 resonances were measured between 0.3 and 1.3 kev. At 2 to 60 kev, the average total cross section σ_T and the average transmission for thick samples were measured. A value of the p-wave neutron strength function can be determined provided the s-wave neutron strength function, the potential scattering length and the average radiation width are known from the low energy data. The same method was used to investigate the average p-wave parameters of U^{238} and Au^{197}. (auth)

14050 THE FISSION CROSS SECTION OF Pu^{241} BETWEEN 3 eV AND 20 eV. G. D. James (Atomic Energy Research Establishment, Harwell, Berks, England). p.115-17 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The fission cross section for Pu^{241} from 3 to 20 ev was measured by the time-of-flight method using 10 mg of 94.9% Pu^{241} and a 15 m flight path. The detector contained four 2-cm diameter silicon gold solid state detectors made from 300 ohms-cm resistivity silicon. 4000×1 μs timing channels were used, giving 0.07 μs/m resolution. A boron filter containing 0.27 g/cm^2 B_4C was used to cut out thermal neutrons. The data were normalized by equating the sum of the areas under the seven resonances between 4 and 11 ev to the sum of the values $\sigma_0\Gamma_f$ found from measurements of total cross sections. (auth)

14051 GENERAL SURVEY ON THE USE OF TIME-OF-FLIGHT METHODS IN THE STUDY OF FISSILE ISOTOPES. E. R. Rae (Atomic Energy Research Establishment, Harwell, Berks, England). p.119-25 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Techniques associated with time-of-flight measurements on the fissile isotopes are discussed, with particular reference to measurements of fission cross sections, eta, fission mass distributions, and resonance spins. Comparisons are made between the techniques available for each type of measurement, and their advantages and limitations are stressed. (auth)

14052 A MEASUREMENT OF THE 2200 m/s FISSION CROSS SECTION OF U^{235}. E. E. Maslin (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.127-9 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A fast neutron chopper was installed and is operating on the Herald reactor at A.W.R.E., Aldermaston. The characteristics of this instrument are similar to those of the Argonne Fast Chopper. It is used to make a measurement of the absolute, thermal, fission cross section of U^{235}. The cross section is being measured using the technique of fission neutron detection from a thick fissile sample. Liquid scintillator capsules, employing pulse shape discrimination of neutrons from γ-rays, are being used as fission detectors. The neutron beam intensity is measured using a sodium iodide crystal that detects the 478-kev γ from a thick B^{10} foil placed in the beam. Time-of-flight spectra are obtained, giving both the numbers of neutrons and the numbers of fissions as a function of neutron energy, by recording pulses from the liquid scintillators and from the sodium iodide crystal in the two halves of a 1024-channel time-of-flight analyzer. (auth)

14053 A MEASUREMENT OF ETA VERSUS ENERGY FOR U^{235}. F. D. Brooks (Atomic Energy Research Establishment, Harwell, Berks, England). p.131-7 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Eta, the number of prompt fission neutrons emitted per neutron absorbed, was measured for U^{235} + n as a function of neutron energy from 0.7 to 50 ev. Fission neutrons were detected by liquid scintillation counters with pulse shape discriminating circuits to minimize sensitivity to capture γ rays. This detector served to measure the fission neutron yield and also, by a "self-indication" method, to measure the transmission of the U^{235} sample. Four different samples were used and the energy range 0.7 to 10 ev was covered with 44 nanosec/m resolution, while the energy range 10 to 50 ev was covered with 11 nanosec/m resolution. (auth)

14054 GENERAL SURVEY ON GAMMA-RAY SPECTRA EMITTED AFTER NEUTRON CAPTURE. J. Julien (Centre d'Etudes Nucléaires, Saclay, France). p.139-49 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The γ spectrum emitted after resonance neutron capture is considered for use without energy analysis or in analyzing certain energy ranges of the spectrum. Applications are presented, the emphasis being placed on the interest of knowing the γ spectra to determine resonance spin, the accumulation of statistical data on nuclear levels, and the understanding of certain anomalies. (auth)

14055 GENERAL SURVEY ON RADIATIVE CAPTURE MEASUREMENTS BY TIME-OF-FLIGHT. J. H. Gibbons (Oak Ridge National Lab., Tenn.). p.151-66 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A review is given of techniques for radiative capture cross section measurements, with emphasis given to 4π-liquid scintillator systems. Experiments using both "white" and "monoenergetic" neutrons are discussed with reference to optimum source types at various energies. Typical experimental results are presented and used to illustrate capabilities as well as to point out areas where improvements or changes in technique are pertinent. (auth)

14056 FLUCTUATION OF THE PARTIAL WIDTHS OF ENERGETIC RADIATIVE TRANSITIONS FOLLOWING NEUTRON CAPTURE IN MEDIUM WEIGHT NUCLEI (Pr AND Ag). APPLICATIONS TO THE DETERMINATION OF THE PROPERTIES OF THE COMPOUND NUCLEUS LEVELS. C. Corge, V. D. Huynh, J. Julien, J. Morgenstern, and F. Netter (Centre d'Etudes Nucléaires, Saclay, France). p.167-9 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The measurement of partial widths for the three most energetic transitions induced by the capture of neutrons

at the three first resonances of Pr exhibits fluctuations. The study of radiative transitions in neutron capture by Ag allows discernment between the resonances of Ag^{107} and Ag^{109} according to their spin. (auth)

14057 NEUTRON RESONANCE CAPTURE GAMMA-RAY WORK AT CHALK RIVER. R. E. Chrien, H. Palevsky, and H. H. Bolotin (Brookhaven National Lab., Upton, N. Y.). p.179-89 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The use of the joint BNL-AECL fast chopper facility at Chalk River for the investigation of γ spectra resulting from slow-neutron capture in resonances is discussed. The NRU reactor, having a thermal flux of about 2×10^{14} $n/cm^2 \cdot s$ serves as a neutron source for a BNL-type chopper located in a cubicle in the reactor shielding. A flight path of 16 m through He is employed. Events are recorded in an array of six 3 in. × 3 in. NaI crystals and are analyzed by a modified version of the Brookhaven 1024-channel electrostatic analyzer. Calibration of the spectrometer line shape is readily accomplished with known thermal capture lines. Data output is on punched paper tape in codes suitable for machine data processing and automatic data plotting. Capture γ spectra in platinum and U^{238} were studied with particular attention to transitions to the ground state and low-lying states. These studies demonstrate that in favorable cases, the complex spectra observed may be decomposed into individual γ components. The interpretation of the data and its significance to the question of fluctuation in γ transition probabilities is discussed. (auth)

14058 SPIN ASSIGNMENT OF RESONANCES FROM CAPTURE GAMMA-RAY SPECTRA. L. M. Bollinger and R. E. Cote (Argonne National Lab., Ill.). p.199-202 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The proposal for determining neutron-resonance spins by observing sum-coincidence γ spectra is explored. The basic idea of the proposed method is that, for a large class of nuclides, the intensity of γ cascades that proceed in exactly two steps from the initial compound state to some particular low-lying state will depend on the spin of the initial state. Using the Argonne 3-parameter magnetic-tape recording analyzer, the sum-coincidence spectra of Mo^{95}, Cd^{111}, Cd^{113}, Hg^{199}, and Hg^{201} are investigated. The measurements are shown to be technically feasible for all these nuclides. Moreover, for Mo^{95}, Cd^{111}, and Cd^{113}, all of which form states with positive parity, the spectra appear to satisfy the statistical requirements necessary to make the method useful. However, for Hg^{199} and Hg^{201}, so few modes give significant contributions of two-step cascades to the ground state that statistical fluctuations may compromise the reliability of the two-step cascade method. Nevertheless, the γ spectra give consistent spin assignments. (auth)

14059 NEUTRON RADIATIVE CAPTURE MEASUREMENTS UTILIZING A LARGE LIQUID SCINTILLATOR DETECTOR AT THE ORNL FAST CHOPPER. R. C. Block, G. G. Slaughter, L. W. Weston, and F. C. Vonderlage (Oak Ridge National Lab., Tenn.). p.203-11 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Neutron radiative capture cross sections were measured from ~200 to 8000 ev for ~25 elements in the atomic weight range $90 < A < 200$. These cross sections agree in the 8000-ev region to within 20 to 25% with results reported by Gibbons, et al. (Phys. Rev., 122: 182(1961)). The 0.7-m diameter spherical liquid scintillator installed at the 11.5-m flight station of the ORNL fast chopper was used to detect the capture γ rays; the high intensity (MI) chopper was utilized for these measurements. A new 1.25-m diameter liquid scintillator (which uses only two 16-in. diameter Dumont photomultiplier tubes) was recently constructed to improve the accuracy of the capture measurements. Tests with γ rays from sources and radiative capture indicate that this 1.25-m diameter scintillator compares favorably with the scintillator detector used by Gibbons, et al. (auth)

14060 A DIRECT COMPARISON OF GAMMA-RAY SPECTRA OBTAINED FROM THE CAPTURE OF THERMAL AND (30 ± 10) kev NEUTRONS. F. W. K. Firk and J. H. Gibbons (Oak Ridge National Lab., Tenn.). p.213-19 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The γ spectra observed using a 9 × 6 in. NaI (Tl) crystal were compared directly for radiative capture of thermal and (30 ± 10)-kev neutrons in Au, Cu, Fe, and Ni. Two sets of measurements were made using neutron time-of-flight techniques on both the ORNL neutron chopper and 3-Mev pulsed Van de Graaff. Identical geometries were used for the NaI (Tl) γ spectrometer in the two experiments. In the Van de Graaff experiment, nanosecond time-of-flight techniques were used for triple-event discrimination, namely: a time separation of γ-rays from the Li target of the machine, the sample under investigation, and capture by I of 30-kev neutrons elastically scattered from the sample into the crystal. For Au and Fe, the γ spectra of above 3 Mev due to capture of thermal or (30 ± 10)-kev neutrons do not differ significantly. However, for Cu and Ni, the γ spectra are significantly different at the two neutron energies investigated. There is evidence that a direct capture process contributes to the thermal neutron capture in Cu. (auth)

14061 GENERAL SURVEY ON THE USE OF TIME-OF-FLIGHT METHODS FOR REACTOR SPECTRUM MEASUREMENTS. M. J. Poole (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.221-32 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The usefulness of time-of-flight methods for obtaining information on the energy spectrum of neutrons inside a reactor is assessed. Attention is given to the energy resolution required to obtain a satisfactory measurement. Difficulties associated with extraction of time-of-flight neutron beams from subcritical assemblies are considered. (auth)

14062 CHOPPER TIME-OF-FLIGHT MEASUREMENTS ON A GRAPHITE URANIUM LATTICE AT DIFFERENT TEMPERATURES. M. S. Coates (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.233-7 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A subcritical graphite uranium lattice was set up on the swimming pool reactor LIDO at Harwell using the reactor core as a neutron source. Details of the lattice are: size: 49 × 49 × 56 in.; fuel: Calder Hall type (natural uranium bar canned in magnox); fuel channels: 3.75 in. dia. running 11 to 56 in. dimension; and pitch: 8 in. (square). The neutron beam spectrum emerging from the inner end of a hole cut into the graphite mid-way between (and parallel to) two fuel channels was measured at up to 320°C by time-of-flight experiments using a chopper. The observed spectra fit a Maxwellian distribution for a neutron energy $E \lesssim 0.1$ ev and a λ/E distribution for $E \gtrsim 1$ ev. The effective temperatures of the Maxwellian distributions are higher

than predicted by the heavy gas model using a mass of 12 for graphite. The behavior of the joining region between the Maxwellian portion of a spectrum and the λ/E tail was analyzed as a function of lattice temperature. A plot of $[E\Phi'(E)/\lambda]$ vs. E/T_N is essentially the same for all spectra. $\Phi'(E)$ is the observed energy spectrum with the Maxwellian portion subtracted. T_N is the temperature of the observed Maxwellian in energy units. (auth)

14063 THE USE OF A T(d,n)He^4 NEUTRON SOURCE FOR SLOW NEUTRON SPECTRUM MEASUREMENTS. K. H. Beckurts and W. Reichardt (Kernforschungszentrum, Karlsruhe, Ger.). p.239-49 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A 400-kev pulsed deuteron accelerator is in use at Karlsruhe. Employing the d,T-reaction, this generator produces short (10^{-8} sec) bursts of 10^8 neutrons that can be used for neutron spectra measurements in assemblies by the time-of-flight method. Although the neutron intensity is much lower than the intensity available with modern linear accelerators, it offers advantages. There is no "gamma flash"; measurements at very short times can be easily done. The target assembly is small; very small systems can be investigated. Measurements were performed on hydrogenous moderators. Demonstration of "diffusion cooling" in small assemblies and thermal and epithermal spectra from finite geometries are discussed. Trends in the development of intense (d,T) pulsed sources and future applications are discussed. (auth)

14064 THERMAL NEUTRON INELASTIC SCATTERING MEASUREMENT WITH THE CHALK RIVER PHASED ROTOR APPARATUS. S. J. Cocking (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.251-7 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Experimental details and results obtained during two years operation are presented. The object was to obtain absolute values of the scattering cross sections ($d^2\sigma/d\Omega \cdot dE$) over as wide a range of energy transfer and momentum transfer as possible. Results are presented to illustrate the range of these parameters covered in experiments completed. Intensities of the monokinetic beam (e.g. 8×10^5 n/min at 0.07 ev) and time-of-flight resolution ($\Delta\tau/\tau$) are given with the methods used for normalizing data to absolute cross section scale. Experimental results are illustrated with examples of scattering by water, vanadium, and beryllium. (auth)

14065 GENERAL REVIEW OF NEUTRON CHOPPER TECHNIQUES. P. A. Egelstaff (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.261-73 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Neutron choppers are employed in a wide variety of experiments. Functions of a neutron chopper are analyzed and various types are described. These include slow and fast choppers and systems of choppers in which several rotors are phased together. Remarks are given on the combination of the neutron chopper with other types of equipment and on its future position in neutron physics research. (auth)

14066 SOME ASPECTS OF THE CALIBRATION OF A SLOW CHOPPER. A. Deruytter (Centre d'Etudes Nucléaires, Mol, Belg.), H. Ceulemans, M. Neve de Mevergnies, and H. Moret. p.275-82 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Calibration of the BR1 slow chopper is described. The ultimate accuracy in neutron speed calibration that can be expected with a slow chopper set-up, is discussed. (auth)

14067 NOTES ON EXPERIMENTAL RESOLUTION WITH PHASED ROTOR NEUTRON VELOCITY SELECTORS. S. J. Cocking (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.283-7 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Experimental resolution is discussed as velocity range in the selected beam, time spread of neutron burst, flight path distance errors, and angular resolution of detectors. A simplification for the relevant transmission function of a single rotor of a twin rotor apparatus is described; it is equivalent to the mechanical fact that the tips of the rotors are responsible for the chopping of the neutrons which are finally passed by the twin-rotor system. This simplification is applied to derive expressions for the velocity spread, the total intensity, and the time spread of the selected beam. It is shown that the standard deviation of the time spread for a fixed beam intensity may be minimized for a specific choice of the ratio of open times of the two rotors. Where inelastic scattering by a sample is being studied, it is frequently the energy change of neutrons during scattering which is required, and an expression is given for the standard deviation of the error in this energy change in a given time channel. The ratio of open times of the rotors that minimizes this error for a given intensity is derived. It is pointed out that there are several possible points of view. The choice cannot be made solely from the consideration given, and, usually, engineering considerations determine the final choice. The resolution errors arising from finite detector geometry are also discussed. (auth)

14068 THE SLOW CHOPPER FACILITY AT THE ISPRA-I REACTOR. R. Haas, W. Kley, K. Krebs, and R. Rubin (Centre Commun de Recherches, Euratom, Ispra, Italy). p.289-92 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A slow chopper facility for studying problems in lattice dynamics of solids and in the dynamical behavior of liquids was installed at the CP-5 reactor at C.C.R., Ispra. The resolution is 10 μsec/m. The chopper has curved slits and is placed between a beryllium filter and the sample. Details of the facility are described. (auth)

14069 A TIME-OF-FLIGHT SPECTROMETER WITH A SEMI-MONOCHROMATIZING CHOPPER. U. Dahlborg, S. Holmryd, K. E. Larsson, and K. Otnes (Research Inst. of National Defence, Stockholm). p.293-5 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A new type of slow chopper intended for use in neutron scattering experiments was constructed. Besides its pulsing action, the chopper serves as a monochromator for the incoming neutrons, depending on its transmission curve, which is much narrower than is usual for slow choppers. If it is operating in connection with a beryllium filter, it gives a transmitted neutron spectrum with a wave length resolution of $\Delta\lambda/\lambda \sim 7.5\%$. This may be compared to the half value width of the whole cold neutron spectrum which is 1Å or $\Delta\lambda/\lambda \sim 30\%$. The time resolution of the analyzing system corresponds to ~12 μs/m. With a distance of 50 cm between the chopper and the sample the actual time resolution is ~15 μs/m. The whole time-of-flight spectrometer was tested experimentally at the Swedish reactor R1, but it is intended to operate at the high-flux reactor R2 in Studsvik. (auth)

14070 LESSONS LEARNED FROM A CHOPPER ACCIDENT. G. E. Thomas, R. E. Cote, and L. M. Bollinger (Argonne National Lab., Ill.). p.297-300 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

An effort was made to increase the speed of rotation of Rotor II of the Argonne fast chopper to 20000 rpm. Between 19000 and 20000 rpm, the rotor suffered a serious non-elastic deformation. It is believed that the deformation of the monel and uranium sections in which the slits were cut might have been less if the bottom plate had been strong enough. The technique used to repair the monel and uranium parts is described. It consisted of compressing the parts using the thermal contraction of a closely fitting steel ring. Measurements on the rotor after a series of these operations indicated that most of the dimensions were restored to their original values, and subsequent use indicates that the operation was completely successful. (auth)

14071 A ROTATING CRYSTAL SPECTROMETER. W. Glaeser (Kernforschungszentrum, Karlsruhe, Ger.). p.301-8 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A rotating crystal spectrometer is described as the primary part of a pulsed source/time-of-flight arrangement for studying the inelastic scattering of slow neutrons. The rotating crystal produces short bursts of monochromatic neutrons, which fall on the scattering sample. The energy distribution of the inelastically scattered neutrons is measured using conventional time-of-flight method. The resolution of the instrument is discussed. Single crystals were tested as monochromators. The monochromator is useful at 4.10^{-3} to 1 ev. (auth)

14072 GENERAL SURVEY ON PULSED ELECTROSTATIC ACCELERATORS AS SOURCES OF PULSED NEUTRONS. W. M. Good (Oak Ridge National Lab., Tenn.). p.309-19 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Neutrons at 2 to 100 kev are produced by positive ions from an electrostatic accelerator bombarding a thin Li^7 target. A description is given of the pulsed ion source, and computations are made giving the available resolution and the expected improvements. It is shown that the method is valuable with small samples. The energy resolution is maintained constant from 2 to 50 kev. A transmission measurement was made on a Se^{80} sample. (auth)

14073 GENERAL SURVEY ON THE SYNCHROCYCLOTRON AS A PULSED NEUTRON SOURCE. J. Rainwater (Columbia Univ., New York). p.321-7 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The effects of timing resolution are reviewed. A description of the Columbia University Nevis Synchrocyclotron used as a slow neutron velocity spectrometer source is given. A comparison is made between the synchrocyclotrons and the fixed frequency smaller cyclotrons. Results obtained in March 1961 for the transmission of iron, bismuth, and thorium are presented. (auth)

14074 GENERAL SURVEY ON ELECTRON LINEAR ACCELERATORS AS PULSED NEUTRON SOURCES. R. Bergere (Centre d'Etudes Nucléaires, Saclay, France). p.329-52 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Electron linear accelerators are used as pulsed neutron sources. Their range of possibilities is discussed, particularly resonant and thermal neutron production and its relation with the accelerator parameters, the neutron resolution function, the availability of short electron and neutron pulses, and the over-all reliability. The improvements planned are discussed. Characteristics of the Saclay linear accelerator are presented. (auth)

14075 NANOSECOND TIME-OF-FLIGHT WITH AN ELECTRON LINAC. C. Sargent, W. Bertozzi, P. Demos, and W. Turchinetz (Massachusetts Inst. of Tech., Cambridge). p.353-5 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The M.I.T. 17-Mev electron linear accelerator was used for fast time-of-flight experiments. Most of the effort was directed toward the measurement of photoneutron spectra at 0.2 to 15 Mev. This makes use of liquid scintillator recoil detectors, relatively long (5 to 20 m) flight paths, and 4-nanosec beam pulse widths. Short-flight-path (1.6 m) work at 10 to 350 kev was performed. Prompt γ from capture in silver provide the detection mechanism, and an effective capture cross section from 10 to 350 kev was measured. Encouraging tests were made using Li glass as a fast detector in this energy range. Background problems encountered in linear accelerator time-of-flight work are discussed. (auth)

14076 A STUDY OF THE SLOWING-DOWN PROCESS OF FAST NEUTRONS TRAVERSING A FINITE THICKNESS OF MODERATING MATERIALS BY MEANS OF THE MONTE-CARLO METHOD. P. Ribon and A. Michaudon (Centre d'Etudes Nucleaires, Saclay, France). p.357-65 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Resolutions obtained from time-of-flight measurements are improving since pulsed neutron sources with very short pulses have become available. But when a slowing-down process is used, the neutron pulse length is largely dependent on the slowing-down time. A calculation is performed to determine the best moderator for a given type of measurement, the resolution function resulting from the slowing-down process used, and the extent to which improvements achieved from short bursts are limited by the slowing-down process. Results are presented that indicate there is no advantage in poisoning the moderator with boron. (auth)

14077 GENERAL SURVEY ON FISSION NEUTRON PULSES: REACTORS AND EXPLOSIONS. G. A. Cowan (Los Alamos Scientific Lab., N. Mex.). p.367-74 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Non-destructive bursts from stationary pulsed fast reactors produce 10^{17} neutrons in a pulse about 50 μsec wide with a pulse repetition rate of several per hour. The unmoderated neutron pulse from a nuclear explosion is less than 0.1 μsec wide. The neutron flux produced by a small nuclear explosion in Nevada was used to obtain a radioautograph of a revolving wheel of U^{235}. (auth)

14078 ASSESSMENT OF THE UTILITY OF THE DIFFERENT PULSED NEUTRON SOURCES. E. B. Paul (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.375-85 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A comparison of pulsed neutron sources is made from the following points of view: relative peak intensity, product of the duty cycle by the relative peak intensity, resolution, intensity divided by resolution, background, sample flexibility, and experimental layout flexibility. (auth)

14079 GENERAL SURVEY ON CHOICE OF THE DETECTOR FOR A TIME-OF-FLIGHT EXPERIMENT. F. D. Brooks (Atomic Energy Research Establishment, Harwell,

Berks, Eng.). p.389-405 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Neutron detectors are reviewed; attention is given to time resolution, efficiency, background discrimination, and dimensions. The special requirements of detectors for transmission and scattering measurements, fission experiments, and capture studies are considered. In the case of scattering and transmission measurements, detectors are surveyed, and their suitability for various neutron energy regions is discussed. (auth)

14080 CAPTURE TO FISSION RATIOS FOR FAST NEUTRONS IN U^{233}, U^{235}, AND Pu^{239}. B. C. Diven and J. C. Hopkins (Los Alamos Scientific Lab., New Mex.). p.407-12 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The ratio of neutron capture to fission cross sections was measured for U^{233}, U^{235}, and Pu^{239} at 9 incident neutron energies from 30 to 1000 kev. A pulsed and collimated neutron beam is passed through the target at the center of a large cadmium-loaded liquid scintillator. Captures and fissions are detected from their prompt γ; scattering is biased out since corresponding prompt pulses are small. Fission neutrons are thermalized in the scintillating solution and provide delayed pulses that identify a fission event. Capture events are not followed by delayed pulses from the scintillator. Corrections are applied for the fissions not followed by delayed neutron pulses and for the effect of backgrounds. This experiment yields values of α to an accuracy of 1 or 2%. (auth)

14081 USE OF A GASEOUS SCINTILLATOR FOR THE STUDY OF THE FISSION CROSS SECTION OF U^{233} BY THE TIME-OF-FLIGHT METHOD. N. Nifenecker, A. Michaudon, and J. Fagot (Centre d'Etudes Nucléaires, Saclay, France). p.413-23 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A gaseous scintillation detector capable of containing up to 2 g U^{233} consisting of 6 independent cells, each viewed by a photomultiplier, is being developed. A systematic study was made with regard to maximum permissible thickness of deposits, absorption of light in the gas and by the cell walls, and long-term stability of the apparatus. The electronics associated with the detector are described, and the first measurements of the fission cross section of U^{233} with the Saclay linear accelerator with a resolution of 30 nanosec/m and 1 g fissile material are presented. (auth)

14082 A Li^6-LOADED GLASS SCINTILLATOR FOR NEUTRON DETECTION. G. G. Slaughter, F. W. K. Firk (Oak Ridge National Lab., Tenn.), and R. J. Ginther. p.425-9 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A cerium-activated, Li^6-loaded glass scintillator of relatively high Li^6 content was developed and used for detecting neutrons at thermal energies to 80 kev. The glass has a decay time of 100 nanosec, and a scintillation efficiency of 12 to 15% that of NaI(Tl). The $Li^6(n,\alpha)T$ reaction in the glass produces a pulse height distribution that peaks at an equivalent electron energy of about 1.6 Mev and exhibits a resolution of 18 to 25%. A time resolution of about 4 nanosec was obtained using a "fast-slow" coincidence system. The efficiency of a glass cylinder 1.5 in. long is 20% for 1-kev neutrons incident parallel to the axis of the cylinder. (auth)

14083 A GAMMA-RAY SPECTROMETER FOR STUDIES OF RESONANT-CAPTURE GAMMA-RAY SPECTRA. L. M. Bollinger, R. T. Carpenter, R. E. Cote, and H. E. Jackson (Argonne National Lab., Ill.). p.431-8 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A description of the characteristics of a large NaI(Tl) scintillator that is particularly well suited to the study of γ from capture in neutron resonances is given. The crystal is 8 in. in diameter and 6 in. thick. It is coupled to a single 9545B EMI photomultiplier through a short lucite light pipe. The resulting system gives a pulse-height resolution width of only 3.5% for 8-Mev γ. The line shape and its dependence on collimation and on the position and size of the source are discussed. An unexpected background peak is observed at about 6.9 Mev. The system is stable. (auth)

14084 A NEW DETECTOR FOR NEUTRON CAPTURE CROSS SECTION MEASUREMENTS. M. C. Moxon and E. R. Rae (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.439-46 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A novel γ detector consisting of a thin plastic scintillator and a graphite γ to-electron convertor was developed to measure capture cross sections by neutron time-of-flight. The detector is analogous to a thick-walled Geiger counter in that its efficiency for γ detection is roughly proportional to the total energy in a γ cascade. This minimizes the variation of efficiency with the multiplicity of the neutron capture radiation. The detector has a low sensitivity to scattered neutrons which is less than 1% of its sensitivity to capture γ rays. Preliminary runs using the detector at the 90-m station of the Harwell Electron Linac, using Ag and Rh samples, yield values of the radiation widths of the resonances in agreement with those listed in BNL-325. (auth)

14085 GENERAL SURVEY ON MULTI-CHANNEL ANALYSER STORAGE TECHNIQUES FOR NUCLEAR EXPERIMENTS. T. K. Alexander, F. S. Goulding, and W. D. Howell (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.449-55 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The design of multi-channel analyzers becomes a problem in systems design when a large number of channels and continuous operation are required. Available cyclic and random access storage devices are compared for use in these systems. Matching the input rate to the recording rate, thus making efficient use of the speed of the storage device, enables the system's capacity to be substantially increased. The use of ferrite-core analyzers is not fully exploited. (auth)

14086 AUTOMATIC CORRECTION OF THE TIME-OF-FLIGHT OF SLOW NEUTRONS MEASURED WITH EXTENDED COUNTER BANKS. Mario Forte (Centre Commun de Recherches, Euratom, Ispra, Italy). p.457-60 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

In time-of-flight measurements of thermal and subthermal neutrons, the resolution width is predominantly determined by the detector size, especially when multiple arrays of counters (e.g. BF_3 counter banks) are used to increase the efficiency. A correction (artificial delay time) of the neutron detection time is introduced, according to the position of the detecting counter. The requirement is that the correction is proportional to the measured time-of-flight, for each counter distance. A simple electronic method, based on the comparison of linear waveforms, was designed for the purpose. Details of circuits operation and performance are described. (auth)

14087 A TRANSISTORIZED 1024-CHANNEL NEUTRON TIME-OF-FLIGHT ANALYSER. G. Colombo, I. De Lotto, and G. Giannelli (Centre Commun de Recherches,

Euratom, Ispra, Italy). p.461-72 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A transistorized 1024-channel neutron time-of-flight analyzer is described. The design was presented at the Conference on Nuclear Electronics (Belgrade, May 15 to 20, 1961). The reasoning that determined the use and the design of a temporary memory, the circuit design conditions, and the experimental results of the instrument are examined. (auth)

14088 GENERAL SURVEY ON SIMULTANEOUS RECORDING TECHNIQUES. Curtis C. Rockwood (Argonne National Lab., Ill.). p.473-87 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Data handling problems found in multi-parameter recording are reviewed and summarized. Characteristics of recording media are compared. Methods are given for arranging two or more memory types so that desirable characteristics of each type may be utilized. The memory hierarchies used in actual systems are described, and possible developments are outlined. (auth)

14089 DATA RECORDING AND SORTING FOR THERMAL NEUTRON SCATTERING LAW EXPERIMENTS. T. K. Alexander, J. Leng, and W. D. Howell (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.491-6 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A system for recording and sorting data in a time-of-flight experiment designed to investigate neutron scattering as a function of energy and angle is described. To achieve the desired resolution, 30 neutron counters and 270 time channels are provided that, on a sample-background sharing basis, necessitate 16200 recording channels. With this channel capacity requirement and a relatively low counting rate (~100 events per second), it is feasible to combine, with advantage, the storage capabilities of a large capacity ($\sim 10^8$ bits) slowly moving magnetic tape with high speed tape playback and rapid sorting of a relatively small (900-channel) magnetic core analyzer. To effect maximum tape utilization and minimize counting losses, digitized neutron events (counter number and time-of-flight) are fed via a five-word store derandomizer prior to recording on the magnetic tape. A 24-track tape is used, 16 for recording neutron events, with the remainder reserved for control codes, a clock track and two monitoring tracks. The sorted information may be rapidly recorded, either on punched cards or on perforated tape. The punched card format is suitable for use with an IBM 704 computer, while the perforated tape may be processed on a Datatron computer or translated to a typewritten record. (auth)

14090 A STUDY OF RADIATIVE PARTIAL WIDTHS BY MULTIDIMENSIONAL ANALYSIS. C. Corge, V.-D. Huynh, J. Julien, J. Morgenstern, and F. Netter (Centre d'Etudes Nucléaires, Saclay, France). p. 497-8 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The multidimensional analyzer at Saclay consists of 1024 timing channels that have a minimum width of $\frac{1}{10}$ μsec, and 64 channels used for amplitude analysis. The apparatus can be used with 256 timing channels and 256 amplitude channels. It is intended for the study of partial radiative widths as a function of neutron energy. (auth)

14091 INSTRUMENTATION OF COMPLEX NUCLEAR DATA MEASUREMENT EMPLOYING MAGNETIC TAPE TECHNIQUES. F. H. Wells, J. G. Page, and I. N. Hooton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.499-507 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Complex nuclear data experiments involve the sorting of information into a large number of channels by analogue to digital encoding methods. Magnetic-tape digital techniques are used at A.E.R.E., Harwell, for storing the outputs of these encoders during the course of the experiment. After the experiment, these tapes, which contain a full record of all the available experimental information, are analyzed by digital computer methods to perform all the necessary arithmetical calculations. It is considered that with this system, the equipment required to be working during the experiment is reduced to a minimum, thus improving reliability and reducing cost when several experiments are in progress simultaneously. A review of the tape recorders and analyzers in use at A.E.R.E., including both the 1 inch tape 16 track 16 bit word parallel writing system is given. Recent designs are described with reference to the following: technique of magnetic tape recording and reading technique with reference to drop out detection and reliability during service, 1-in. tape derandomizer circuits, $\frac{1}{4}$-in. tape storage system, $\frac{1}{4}$-in. tape digital read-out single-channel analyzer. (auth)

14092 GENERAL SURVEY ON ANALYSIS OF NEUTRON MEASUREMENTS BY TIME-OF-FLIGHT METHODS; TRENDS IN THE NEAR FUTURE. A. Pages, M. Avril, and R. Moreau (Centre d'Etudes Nucléaires, Saclay, France). p.509-16 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

After a criticism of the limitations involved in the existing time-of-flight and multidimensional analyzers, general lines of functional solutions in the future are presented, which remove difficulties due to the limited number of digits and allow flexibility in the association of units. A description is given of the functions involved. (auth)

14093 SYSTEM DESIGN OF COMPLEX NUCLEAR DATA INSTRUMENTATION EQUIPMENT. J. R. Bird and F. H. Wells (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.517-22 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Time-of-flight analyzers were built to suit one kind of experiment. Experiments were carried out by storing data on paper tape or cards and analyzing the results in a digital computer. The latter method was limited to isolated experiments with low count rates. The use of magnetic tape as a storage medium makes it possible to combine the two methods and design a multi-purpose data handling system. Such a system must cover the following: (1) sorting of the primary data into a large number of channels, e.g. 4000 or more; (2) scaling the events occurring in each channel; (3) simple calculations, e.g. adding or subtracting spectra; and (4) adequate numerical and graphical display of the information at all stages. For a large research establishment, the most efficient and useful arrangements of equipment is magnetic tape storage after (1), followed by tape analysis in a small special purpose computer for (2) and (3). This computer should have sufficient capacity and logics available to provide output numbers in the most useful form (4). Final complex calculations of nuclear constants would be performed by a large digital computer. (auth)

14094 GENERAL SURVEY ON MULTICHANNEL ANALYSER TECHNIQUES. PRACTICALITY OF ALTERNATIVES INCLUDING RECORDING TECHNIQUES. C. H. Westcott (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.523-8 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A survey of problems in multidimensional analysis and data handling is given, and the following are discussed: the necessity of the presentation of data during recording; the problem of standardization of codings for paper tape to avoid additional errors introduced by code converters; and preserving of magnetic tape records over longer times to avoid the introduction of errors. Procedures of data handling with emphasis on the systems employed at Chalk River are mentioned. (auth)

14095 GENERAL SURVEY ON METHODS OF THEORETICAL ANALYSIS OF DATA. A. Michaudon (Centre d'Etudes Nucléaires, Saclay, France). p.531-43 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The following methods used in the analysis of data are discussed: total area method, shape analysis, partial area method, systematic use of the interference term, and capture γ-ray analysis. A means of deriving a complete set of parameters is also considered. (auth)

14096 IMPROVEMENTS IN THE ANALYSIS OF THE RESULTS OF TRANSMISSION MEASUREMENTS. C. Corge, V.-D. Huynh, J. Julien, J. Morgenstern, and F. Netter (Centre d'Etudes Nucléaires, Saclay, France). p.545-8 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The method of partial areas was improved and generalized by considering the Doppler effect and the effect of finite resolution in the single level Breit-Wigner formula $\sigma(x) = (\sigma_0/1 + x^2)(1 + xtgK) + \sigma_p$ where σ_0 is the maximum total cross section, σ_p is the cross section for potential scattering, K is equal to twice the hard sphere scattering phase shift $x = [2(E - E_R)/\Gamma]$, and Γ = the width at half-height of the resonance. Calculations were made in the case in which the phase shift is zero, using the Ferranti-Mercury computer. The results were presented in the form of families of curves giving the partial areas as a function of $n\sigma_0$, where n is the number of target nuclei per cm^2 of the sample. Each curve is characteristic for a value of the Doppler effect. Calculations for non-zero values of the phase shift are in progress, using the IBM-7090 computer at Saclay. "The half-width method," which makes use of the width at half-depth of the transmission dip, is presented. The results were also presented graphically. The generalization for depths other than half is being developed. (auth)

14097 AUTOMATIC ANALYSIS OF THE RESULTS OF TRANSMISSION MEASUREMENTS USING THE IBM 7090 COMPUTER. G. Bianchi and C. Corge (Centre d'Etudes Nucléaires, Saclay, France). p.549-53 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

As a consequence of the accumulation of large amounts of experimental data from neutron time-of-flight transmission experiments, it is necessary to consider automatic methods of analysis using an electronic computer. The method of partial areas reduces to the determination of the parameters β, φ or σ_0 by the solution of an over determined system of m equations of the type $(1/\Delta)\ A_R(\beta,\varphi,\alpha,n\sigma_0,K) = [(1/\Delta)A_R]_{exp}$. The choice between possible solutions is made by a least squares method. The starting values can be determined directly from the raw experimental data without a calculation, at least in the case where K equals zero. Automation of the analysis is only complete to the extent that the second terms are themselves calculated electronically. Programs were written to solve this problem. Such computations generally consist of three main steps, viz: the calculation of the dead time correction, the calculation of the shape of the background spectrum, and the calculation of transmissions and partial areas. The method using the width at f times the height of the resonance, which generalizes the half-height method, boils down to the solution of an over-determined system of m equations $\gamma_f(\beta,\varphi,n\sigma_0) = (\gamma_f)_{exp}$. The program for the solution of these equations is being written. (auth)

14098 SHAPE AND AREA ANALYSIS OF LOW ENERGY NEUTRON RESONANCES USING AN IBM-7090 COMPUTER. J. A. Harvey and S. E. Atta (Oak Ridge National Lab., Tenn.). p.555-61 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Two programs for analyzing transmission data to obtain parameters of the resonances were written for the IBM-704 and IBM-7090 computers. The first program is a shape fit analysis for determining the resonant energies, total widths, and neutron widths of the resonances. The second program is an area analysis for determining the neutron widths of the resonances for assumed total widths. It is assumed that the total cross section can be represented by the sum of single level Breit-Wigner formulas, with interference between resonances and potential scattering but no interference between resonances; that the Doppler broadening is represented by a Gaussian function; and that the instrument resolution is represented by a Gaussian function. Some techniques are used for evaluating the integrals in the function for calculating the transmission. Both programs use Gauss' method of reducing the problem to one in which linear methods can be applied. The area program analyzes regions of the transmission data containing up to 20 resonances at once. The shape fit program analyzes the transmission data for up to 6 resonances at once. (auth)

14099 ANALYSIS OF RESONANT-CAPTURE GAMMA RAY SPECTRA. R. T. Carpenter, J. P. Marion, and L. M. Bollinger (Argonne National Lab., Ill.). p.563-4 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Techniques for quantitative analysis of γ spectra from neutron capture of resonances are described. In the most general case, the γ spectra from all observed resonances in a given nuclide are treated simultaneously. A least-squares fit is performed to obtain the energies of a given number of γ lines (which are the same for all resonances in a given nuclide), the intensities of the transitions (which vary from resonance to resonance), and the statistical errors associated with these quantities. The simultaneous treatment minimizes the errors in the energies. The treatment can be reliably applied to spectral regions in which the lines are partially resolved in any of the resonances. The reference line shapes, which are allowed to depend on the γ energy, are calculated by interpolation between line shapes given to the computer in tabular form for single transitions at various energies. Any physical knowledge of the intensities and energies of any of the lines in the spectra may be fed into the problem as linear constraints. Special cases of the most general calculation are permitted. The calculations are performed on an IBM-704 digital computer. (auth)

14100 AN EXAMPLE OF THE HANDLING OF TIME-OF-FLIGHT DATA. A. Michaudon and P. Ribon (Centre d'Etudes Nucléaires, Saclay, France). p.565-70 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

Electronic computers are increasingly used for obtaining the best evaluation of data from time-of-flight measure-

ments. An attempt to ensure a fairly automatic analysis of the results and—in the case of transmission measurements, for example—to obtain both cross sections and partial areas is described. At each stage, facilities are provided to plot out the relevant curves. Programs are used for adjusting, by a least squares method, the parameters of a theoretical law (Breit-Wigner single or multilevel formula) to the experimental results. These programs include a broadening by Doppler and resolution effects. They are in use on a Ferranti-Mercury machine and are now repeated on an IBM-7090. Examples of results are given. (auth)

14101 GENERAL SURVEY ON THE UTILIZATION OF MULTILEVEL FORMULAE. N. J. Pattenden (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.571-9 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

A general survey of multilevel analysis methods as applied to slow neutron cross section measurements is given. An evaluation is made of the strengths and weaknesses of these methods at their present stage of development. (auth)

14102 APPLICATION OF A MULTILEVEL FORMULA TO SCATTERING RESONANCES. C. Corge, V.-D. Huynh, J. Julien, J. Morgenstern, and F. Netter (Centre d'Etudes Nucléaires, Saclay, France). p.581-2 of "Neutron Time-of-Flight Methods." Brussels, European Atomic Energy Community, 1961.

The analysis of resonances at neutron energies of 215.6 and 231.7 ev in Pr^{141} allows a spin assignment of J = 3 for the resonance at 215.6 ev. Consideration of interference effects between these two resonances allows assignment of the value J = 3 for the spin of the resonance at 231.7 ev. (auth)

Particle Accelerators

Refer also to abstract 13349.

14103 (AFCRL-62-249) PLASMA BETATRON PROBLEMS. Scientific Report No. 2. M. A. Levine (Air Force Cambridge Research Labs., Bedford, Mass.) and A. G. Rubin (Williamson Development Co., Inc., West Concord, Mass.). Jan. 31, 1962. Contract AF19(604)-4091. 28p.

Methods of design of pulsed air core betatron coils are presented. The properties of several magnetic field configurations and their application to betatrons are discussed. The adopted design is described in detail. The method used to make measurements of the betatron field is described. The design and operation of a pulsed r-f amplifier for producing plasma for betatron injection is discussed. A shorted coil system for measuring the gas current in a plasma betatron is described. The construction and properties of a doubleshielded oscilloscope enclosure are described. (auth)

14104 (DESY-A2.84) MESSUNGEN AN DEN DESY-MAGNET-MODELLEN. TEIL A. MESSVERFAHREN MIT SPULE UND INTEGRATOR. (Measurements on the DESY-Magnet Models. Part A. Method of measurement with Coil and Integrator). (Deutsches Electronen-Synchrotron, Hamburg). Dec. 19, 1961. 62p.

The principles of magnetic field measurements with coil and integrator are summarized. Methods for determining field strength, field index, and other parameters are outlined. The use of the coil in the measurements is described The influence of the manufacturing tolerance, the practical construction of the coil, and the gaging of the coil are discussed. The principles and design of the electron integrator are described. Measurement practices are outlined including a study of the integrator's limits and the places of measurement. (M.C.G.)

14105 (IFA-M-24) FIELD INDEX DETERMINATION BY THE POTENTIAL NETWORK METHOD. C. C. Iliescu (Academia R. P. R. Institutul de Fizica Atomica, Bucharest). Sept. 21, 1961. 7p.

Previously deduced results are used to establish formulas which are presented for application to the n-value (field index value) calculation related to particle focusing, starting from the potential network. The method is illustrated by numerical examples. (J.R.D.)

14106 (IFA-M-25) FIELD INDEX DETERMINATION BY THE EQUIPOTENTIAL METHOD. C. C. Iliescu (Academia R. P. R. Institutul de Fizica Atomica, Bucharest). Oct. 14, 1961. 11p.

An investigation concerning accuracy limits of the field index determination by the equipotential method is described. The applicability of the method for design of weak focusing and strong focusing nuclear instruments is examined. The electrolytic tank is inadequate for large, weak-focusing nuclear instruments but very useful for small weak- or strong-focusing instruments. (J.R.D.)

14107 (NIRL/R/13) ON THE APPLICATION OF STOCHASTIC ACCELERATION TO A SYNCHROCYCLOTRON. F. M. Russell and P. S. Rogers (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England). July 1961. 27p.

The use of an auxiliary dee at the center of a synchrocyclotron fed by either noise of a carefully programmed frequency-time signal is examined with the object of increasing the internal beam intensity. The experimental results are in fair agreement with the predicted performance of such a scheme. No significant gain in beam intensity was achieved using either of the schemes described. (auth)

14108 (NIRL/R/17) SOME HIGH-CURRENT CIRCUITS USING TRANSISTORS. J. T. Hyman (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England). Jan. 1962. 23p.

Some high-current transistor circuits, developed in connection with work on the NIMROD Injector, are discussed. Details are given of the performance of these circuits and of their applications. (auth)

14109 (NP-11554) BEAM STUDIES ON THE U.C.L.A. 50 MEV SPIRAL-RIDGE CYCLOTRON. David J. Clark (California. Univ., Los Angeles). Jan. 1962. Contract Nonr-233(44). 103p.

A description of the cyclotron is given along with a review of early development. The present magnetic field is discussed and information obtained in orbit calculations is presented. Experimental beam observations including operating conditions, beam intensity characteristics, RF knockout measurements, and other observations are outlined. (J.R.D.)

14110 (TID-15154) LINEAR ELECTRON ACCELERATOR STUDIES. Final Report. (Stanford Univ., Calif. Stanford Linear Accelerator Center). Dec. 1961. Contract AT(04-3)-21. 88p. (ML-882; M-291)

Progress is reported on the Mark IV program, accelerator structure and high-power waveguide component studies, injection system development, microwave circuit development, klystron studies, high-power klystron window design, modulator studies, vacuum system development, support and alignment, control system studies, research area design, site and building development, water system development, and heating and ventilating. (M.C.G.)

14111 USE OF THE AUTOCORRELATION PRINCIPLE IN VERY HIGH-ENERGY CYCLIC ACCELERATORS. E. L. Burshteĭn, A. A. Vasil'ev, A. L. Mints, V. A. Petukhov, and S. M. Rubchinskiĭ. Atomnaya Energ., 12: 111-15(Feb. 1962). (In Russian)

Discovery of the phase stability made it possible to design accelerators with a weakly-focusing magnetic field capable of reaching levels of several Bev. The recently developed automatic regulation of the local characteristics of the magnetic field resulted in the reduction of the cross section of the chamber, allowing increase of the energy while simplifying the design of the system. Perturbance pulses creating coherent betatron oscillations were used for measuring the frequency of the betatron oscillations. A method involving the "first revolution" during which the magnetic field is not adjusted yet is reviewed, using it for computing the parameters of small-aperture 300- and 1000-Bev accelerators. As an example, a 3-cascade accelerator is described; it consists of an initial 50-Mev linear accelerator, similar to the CERN machine, a small, several-Bev circular pre-accelerator and a large small-aperture circular accelerator. (TTT)

14112 THE LINEAR ELECTRON ACCELERATOR. G. I. Zhileĭko. Atomnaya Energ., 12: 147-9(Feb. 1962). (In Russian)

The linear electron accelerator represents a suitable device for experimentation with electron beams. The energy of the electron may be varied within the range of 0.5 to 5.4 Mev by changing the frequency of the accelerating field; the duration of the high-frequency pulses is also within the control of the operator within 0.1 to 2 microsec. The 2-m long waveguide consists of a pipe with a uniform diameter. The phase velocity is increased by increasing the diameter of the aperture by means of diaphragms from 0.11 to 0.16 λ where λ represents the wavelength of the oscillation of the accelerating field in free space. The function of the dependence of the electron energy on the frequency of the accelerating field agrees well with the calculated curve although there is a difference of 1.5% in points at which the phase velocity of the wave is equal to the velocity of light. The efficiency coefficient of the accelerating waveguide reaches 30 to 50% at beam energies of 3 to 4 Mev, agreeing well with theoretical values. Upon further increase of the energy to 5 to 5.4 Mev the efficiency is decreased by 15 to 20%. (TTT)

14113 VAN DE GRAAFF PROTON SOURCE RECEIVES 110 KILOVOLT BOOSTS. E. J. Rogers (Brookhaven National Lab., Upton, N. Y.). Electronics, 35: No. 13, 58-9 (Mar. 30, 1962).

An accelerator injects protons into Cosmotron orbit at 5 minute intervals. During proton injection the Van de Graaff terminal capacitance discharges reducing terminal voltage, hence reducing initial proton energy. An auxiliary boost circuit counteracts voltage loss and matches proton energy to Cosmotron magnetic field. The secondary output of a pulse transformer breaks down modulator airgap and initiates the 110 kv pulse that the Van de Graaff liner couples to the proton source. (P.C.H.)

14114 THE R.F. SYSTEM FOR THE PRINCETON-PENNSYLVANIA ACCELERATOR. J. L. Kirchgessner, D. Barge, G. K. O'Neill, G. Rees, and J. Riedel (Princeton Univ., N. J.). IRE Trans. on Nuclear Sci. NS-9, No. 2, 11-18(Apr. 1962).

Design and discussion are given on the complete radio-frequency system for the Princeton synchrotron and also on the drift tube system, cavity system, cavity bias system, phase detectors, accelerating station, and the master oscillator. The synchrotron floor plan is given along with a block diagram of the complete r-f system. The r-f accelerating system, which operates on the 8th harmonic of the beam rotation frequency, must cover the range 2.5 to 30 Mc. The frequency must be a function only of the magnetic guide field, and track the time varying guide field with an accuracy of 0.05%. (P.C.H.)

14115 WIDEBAND PRECISION PHASE DETECTOR. C. L. Kang (Princeton Univ., N. J.). IRE Trans. on Nuclear Sci. NS-9, No. 2, 26-31(Apr. 1962). (PPAD-428E)

A phase error detecting system designed for the r-f system of the 3-Bev Princeton-Pennsylvania Proton Synchrotron is described. It serves as a link in the servo loop to keep ferrite tuned r-f load to track the driving signal which sweeps from 2.5 to 30 Mc at repetition rate of 20 cps. The input signals are shifted to a constant intermediate frequency of 455 kc by mixing with a specially generated tracking signal. Limiting, phase shifting, and the phase detection are all done at 455 kc. Its output phase lag for phase modulation frequency below 50 kc is less than 90°. It has a usable range of 40 db input variation. Zero output accuracy is ±2° for the range of 20 db input variation. All circuits, except the tracking signal generator are transistorized. (auth)

14116 SOME ASPECTS OF ELECTRON BEAM OPTICS AND X-RAY PRODUCTION WITH THE LINEAR ACCELERATOR. J. Haimson (Varian Associates, Palo Alto, Calif.). IRE Trans. on Nuclear Sci. NS-9, No. 2, 32-49 (Apr. 1962).

A mathematical presentation of linear accelerator fundamental design parameters leads to optimization formulas for x-ray output and operational stability. A narrow spread of electron energies is desirable in most linear accelerator applications and especially when post-acceleration beam bending is utilized to project a stable high energy x-ray beam at right angles to the accelerator waveguide. Some consideration is also given to electron source optics and an analysis of a chopped prebunched injection system is presented together with a comparison of different types of buncher design with emphasis on obtaining narrow energy spectrum small cross-section electron beams. A method of analyzing prebunched injection current and buncher acceptance characteristics is described. (auth)

14117 AN EXTERNAL BEAM BUNCH SELECTOR FOR A 60-INCH CYCLOTRON. T. E. Fessler and J. S. Vincent (National Aeronautics and Space Administration, Cleveland). IRE Trans. on Nuclear Sci. NS-9, No. 2, 50-2(Apr. 1962).

An external beam-bunch selector was built to modulate the beam of the NASA 60-inch cyclotron for neutron time-of-flight studies. Electrostatic deflection at one-fourth the cyclotron frequency is used to lengthen the beam burst period, so that longer flight times can be used. The design and performance of this apparatus are described. With this equipment, flight times up to 400 nanoseconds are available, without distortion of the cyclotron beam burst width. Energy resolutions of the order of 2% are thus possible. (auth)

14118 DESIGN FEATURES OF A HIGH-CURRENT PULSED ELECTRON ACCELERATOR. W. A. S. Lamb (Univ. of California, Livermore). IRE Trans. on Nuclear Sci. NS-9, No. 2, 53-6(Apr. 1962). (UCRL-6699)

The design features of an induction electron accelerator which is under construction at the Lawrence Radiation Laboratory at Livermore, California, are described. The basic parameters are beam energy 4 Mev, beam current 200 amperes, pulse length 0.25 μsec, repetition rate 60 per second. The design beam quality is to be $<10^{-2}$ radian-cm

and the energy spread is to be ±0.5% during the useful part of the pulse. The accelerator consists of a gun whose output is 720 kev, followed by six modular units of 570-kev output each. Several unique components were developed for use on this machine; among them are a 10-inch-diameter cathode and an accelerating column made of metal-ceramic seals 14 inches in diameter for use on the gun. This accelerator is being constructed for use in experiments on the Astron concept for heating and containing hot plasma. (auth)

14119 CYCLIC ACCELERATOR WITH TRAJECTORY CONTROL BY HIGH-FREQUENCY FIELD. A. A. Vorob'ev and E. S. Kovalenko (Tomsk Polytechnic Inst., USSR). Izvest. Vysshikh Ucheb. Zavedenĭ, Fiz., No. 5, 36-8(1961). (In Russian)

A theoretical analysis was made of the advantages of a cyclic accelerator scheme with particle trajectories controlled by a moving, high-frequency electromagnetic field. (R.V.J.)

14120 COUPLING RESONANCES IN SPIRAL SECTOR ACCELERATORS. L. J. Laslett and A. M. Sessler (Midwestern Universities Research Assn., Madison, Wis.). Rev. Sci. Instr., 32: 1235-52(Nov. 1961).

Theoretical and computational results are presented to illustrate the behavior of single particle motion in spiral sector FFAG accelerators of small flutter factor when operated in the neighborhood of vertical-radial coupling resonances. The theoretical analysis proceeds from the approximation in which the radial motion is determined without consideration of the vertical motion, and this solution is then inserted into the linearized equation for the vertical motion. The resulting generalized Hill equation is analyzed by a variational technique which yields both the bands of instability of the vertical motion and the exponential rate of growth within these zones. This mathematical analysis is confirmed by a computational study of the Hill equation used in the theoretical analysis. Extensive computational results are presented of the actual particle motion near coupling resonances for a choice of parameters characteristic of both full-scale accelerators and models. Attention is concentrated on defining the regions of instability and determining the rate of vertical growth, both of which are seen to be in semiquantitative agreement with the theoretical analysis. (auth)

14121 FEASIBILITY OF ACCELERATING POLARIZED PROTONS WITH THE ARGONNE ZGS. David Cohen (Argonne National Lab., Ill.). Rev. Sci. Instr., 33: 161-9 (Feb. 1962).

A computing program was developed for simultaneously tracing trajectories and classical, relativistic spin precessions around the zero gradient synchrotron (ZGS). Depolarizing resonances were found and their properties were computed; there were 36 significant resonances, 12 of which were serious. A method was proposed for avoiding these 12 resonances by using two or four pulsed quadrupole magnets around the ZGS ring. These would rapidly shift the vertical betatron oscillation frequency, at appropriate energies during the acceleration cycle. With this method, a proton beam, injected into the ZGS with P = 1, would have P > 0.7 at the end of the acceleration cycle. (auth)

14122 BEAM LOADING OF A RADIO-FREQUENCY CAVITY. V. Kelvin Neil (Univ. of California, Livermore). Rev. Sci. Instr., 33: 169-71(Feb. 1962).

The interaction of a beam of charged particles in an accelerator with the radio-frequency cavity that provides the accelerating electric field is investigated for the condition that the characteristic frequency of the cavity need not coincide with a harmonic of the beam circulation frequency. It is shown that by proper tuning (appropriate choice of cavity inductance) it is possible to minimize the power consumed in the external driving circuit by bringing the cavity-wall currents into phase with the external generator. The power delivered to the beam and the cavity walls is not affected by the tuning. A high-Q cavity is advantageous if the system is properly tuned. A numerical example is given that indicates that the necessary change in the eigenfrequency is of the order of 1%, and that the resulting reduction in power requirements may be quite significant. (auth)

14123 TWO-MILLION-VOLT ELECTROSTATIC ACCELERATOR FOR HYPERVELOCITY RESEARCH. J. F. Friichtenicht (Space Technology Labs., Inc., Canoga Park, Calif.). Rev. Sci. Instr., 33: 209-12(Feb. 1962).

A 2-Mev Van de Graaff positive ion accelerator is modified to accelerate micron-sized charged particles for studies of high speed impact and for micrometeor simulation. Modification is accomplished by replacing the ion source with a particle charging and injection system. The particles are contact charged to values resulting in electric field strengths at the surface of the particle of about 2.5×10^9 v/m. Using iron spheres, final velocities up to 14 km/sec are observed. Techniques for measurement of particle parameters are developed, and measurements of the focusing properties of the modified accelerator are discussed. (auth)

14124 NEUTRALIZATION OF FRINGING MAGNETIC FIELDS IN THE ION SOURCE OF A MASS SPECTROMETER. P. Marmet, J. D. Morrison, and D. L. Swingler (Commonwealth Scientific and Industrial Research Organization, Melbourne). Rev. Sci. Instr., 33: 239-40(Feb. 1962).

For a fringing magnetic field on the order of 30 gauss, two magnetic coils are placed symmetrically near the ion source. These coils are put in series with, and in opposition to, the main magnet, and may be adjusted to lower the residual field at the source to about 2 gauss. A Mumetal shield is located around the source. A second pair of coils, connected in parallel to a-c, are then used to produce a nearly saturating field in the Mumetal; as a result of a hysteresis effect, the magnetic field inside the Mumetal shield is reduced to about 0.01 gauss. This field value is small enough that an electron velocity selector may be operated in the ion source. (T.F.H.)

14125 CALCULATION OF BEAM LOADING IN LINEAR TRAVELING WAVE ELECTRON ACCELERATORS. A. J. Lichtenberg (Univ. of California, Berkeley). Rev. Sci. Instr., 33: 395-6(Mar. 1962).

The equation used for the total field at the particle in a linear accelerator is $E_T = E_1 \sin \phi \exp(-z/2\, l_\theta) - r_s I \sin^2 \phi\, [1 - \exp(-z/2\, l_\theta)]$, where E_T = peak initial field, ϕ = bunch position relative to the zero of the field, z = distance along the accelerator, I = average current in beam, r_s = shunt impedance of accelerator, and l_θ = loss length. The factor $\sin^2\phi$ in the second term on the right hand side, due to considering the effect of the beam loading to be centered on the wave peak rather than on the particle bunch, is shown not to appear when the total field is computed by superposition. The change of ϕ with beam loading is discussed. (D.L.C.)

14126 ON THE CONSTRUCTION OF THE ELECTRON SYNCHROTRON (DESY) IN HAMBURG. Fritz Leonhardt (Brückenund Hochbau, Stuttgart). VDI Zeitschrift, 104: 100-3(Jan. 21, 1962). (In German)

The high degree of proficiency required in the construction of the electron synchrotron is discussed. The specifications stipulate an alignment of the annular magnet to

within 0.1 mm and that its position remain unaltered. This specification must be met even though the pressures bearing on the foundation soil are not uniform and might lead to ground shifts due to the very heavy construction units necessary for radiation shielding. (N.W.R.)

14127 LINEAR PARTICLE ACCELERATOR APPARATUS. (to Varian Associates). British Patent 891,983. Mar. 21, 1962.

A linear accelerator is designed which gives a large power output and delivers a beam of high-energy particles with variable energy. The accelerator comprises means for projecting a beam of particles along a rectilinear path, a source of r-f wave energy, first accelerating means fed with r-f to accelerate the particles to nearly the velocity of light, means for taking the r-f energy from the first accelerating means and controlling its magnitude without shifting its phase, and a second accelerating means fed with the modified r-f. Details of the accelerator are given in British Patents 891,984, 891,985, and 891,986. (D.L.C.)

14128 LINEAR PARTICLE ACCELERATOR APPARATUS. (to Varian Associates). British Patent 891,984. Mar. 21, 1962.

A circuit is described for reducing the sagging of the high-voltage pulses in the secondary winding in a linear accelerator which accelerates particles with r-f energy. The circuit comprises a pulse transformer with its primary winding driven from a pulse generator and a capacitive load coupled into the secondary winding. General descriptions of the linear accelerator are given in British Patent 891,983. (D.L.C.)

14129 LINEAR PARTICLE ACCELERATOR APPARATUS. (to Varian Associates). British Patent 891,985. Mar. 21, 1962.

A description is given of the first beam accelerating section of the linear accelerator described in British Patent 891,983. The section comprises a hollow slow-wave structure with a plurality of centrally apertured conductive disc members forming a plurality of cavity resonators. R-f energy is fed into the section via a waveguide, and the phase velocity is increased throughout the section by variation of the disc spacing and outside diameters. (D.L.C.)

14130 LINEAR PARTICLE ACCELERATOR APPARATUS. (to Varian Associates). British Patent 891,986. Mar. 21, 1962.

A scanner head and associated parts are designed for use in the linear accelerator described in British Patent 891,983. The parts include the scanner head, a beam-deflecting magnet, a beam collector, and a beam output window. (D.L.C.)

Plasma Physics and Thermonuclear Processes

14131 (AD-261669) THEORETICAL INVESTIGATIONS AND DESIGN STUDIES FOR THE EVENTUAL CONSTRUCTION OF A MEASURING DEVICE IN THE FIELD OF PLASMA ELECTRONICS. Monthly Technical Status Report No. 17, December 1–December 31, 1960. (Battelle Institut e. V., Frankfurt am Main). Jan. 31, 1961. Contract DA-91-591-EUC-1018 OI-1165-59. 10p.

Phase measurements were performed according to the null methods at 3100 mc in connection with the study of plasma penetration using heterodyne techniques. The angular deflection of electromagnetic waves passing through the atmosphere was studied by means of an antenna arrangement. The mean refraction angle corresponded well with theoretical values. (auth)

14132 (AD-261920) STUDY OF A SEEDED PLASMA (thesis). Robert Sylvester Buchanan (Michigan. Univ., Ann Arbor). 1961. Contract AF33(616)-8126. 134p.

The method of increasing the electrical conductivity of a gas (working fluid) by introducing a foreign element (seeding element) into the gas flow is studied, and the properties of the resulting plasma are determined. The alkali metals, alkaline earths, and aluminum which possess relatively low ionization potentials (3.8 to 7.6 electron volts) are considered as favorable seeding elements and analyzed. (auth)

14133 (AFCRL-62-250) STUDIES AND INSTRUMENTATION RELATING TO HIGH ENERGY DENSITY PLASMA EXPERIMENTS. Final Report. Alan S. Anderson, Allen G. Rubin, and Ivan A. Nichols (Williamson Development Co., Inc., West Concord, Mass.). Feb. 28, 1962. Contract AF19(604)-4091. 20p.

Results and instrumentation of experiments on very low pressure gas breakdown are described. An explanation of the breakdown characteristics is set forth. The development of measurement techniques for the investigation of the high energy density induction plasma accelerator referred to as the plasma betatron is described. The plasma betatron is an induction accelerator in which particles of both signs are accelerated at the same time to keep the beam electrically neutral and remove the space charge limit to beam current. Further developments in the plasma betatron and low gas pressure breakdown, supporting equipment, and measurement instrumentation for the study of transient phenomena connected with magnetically driven plasmas and exploding wires are outlined. Particle accelerator studies, water capacitor energy storage studies, and instrumentation are also discussed. (auth)

14134 (AFCRL-837) A REVIEW OF THE MACROSCOPIC EQUATIONS FOR A NON-REACTING PLASMA. Scientific Report No. 149 [on] IONOSPHERIC RESEARCH. S. Chandra (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). July 1, 1961. Contract AF19 (604)-4563. 25p. (AD-262800)

The macroscopic equations for a nonreacting plasma are deduced using the classical Maxwell-Boltzmann equation. The general form of these equations is presented in a rotating coordinate system, taking into account the gravitational and electromagnetic fields, but neglecting relativistic and quantum mechanical effects. (auth)

14135 (AFOSR-990) THE ELECTRICAL PROPERTIES OF IONIZED FLAMES. PART II. ELECTROSTATIC AND MAGNETOHYDRODYNAMIC DEFLECTION. Thomas H. Dimmock, G. F. Miller, J. J. Nichol, and W. R. Kineyko (Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.). Aug. 1961. Contract AF49(638)-305. 32p. (AD-262368)

The electrical properties of H_2-NO and H_2-O_2 seeded, highly ionized, high-temperature flames are investigated to determine the interaction of the flame with electric and or magnetic fields. With electric fields alone, no deflection is obtained because the field intensity within the flame is too small, whether the field electrodes are outside or inside of the flame. Most of the potential drop between the electrodes occurs at the boundary layer on the electrodes. With an unseeded flame, however, electrostatic deflection up to 45° is readily obtained. A combination of transverse electric and longitudinal magnetic fields produces a Lorentz force on the flame of 10 newton/m^3; this force deflects a highly ionized flame up to 45°. The deflection is proportional to the Lorentz force and inversely proportional to

the inertial force. The magnitude of the flame ionization determines the power supply requirements for the electric field; the power required for the electric field decreases with increasing flame ionization. (auth)

14136 (AFOSR-1159) STUDY OF DRAG OF CHARGED BODIES IN A PLASMA. Final Report. (Maryland. Univ., College Park). May 31, 1961. Contract AF49(638)-899. 4p. (AD-261570)

An outline is given of the results of a study of the potential shielding of a charged body (e.g., a satellite) in a plasma (e.g., the Van Allen belts), and of the resultant drag on the body by the plasma. (T.F.H.)

14137 (MATT-63) PRELIMINARY STUDIES OF A REFLEX ARC. R. L. Bingham, F. F. Chen, and W. L. Harries (Princeton Univ., N. J. Plasma Physics Lab.). Feb. 1, 1962. Contract AT(30-1)-1238. 137p.

The operation of a 5- to 11-foot long 2 in. diameter hot-cathode He discharge in a strong magnetic field was investigated. The geometry is that of a Philips Ionization Gauge, and the cathode was a solid slab of W heated to emission by electron bombardment. Because of the reduction in transverse diffusion of electrons caused by the magnetic field, the potential in the center of the discharge was found to be depressed to nearly the cathode potential. Consequently, most of the ionization occurs near the edge of the discharge, and the density and electron temperature on the axis are also somewhat lower than at larger radii. Since enhanced diffusion is likely to be important in the operation of such a discharge, the characteristics of the potential fluctuations in the plasma were studied as well as the time-averaged characteristics of the arc. The frequency spectrum was found to be concentrated at very low frequencies, and rms values of the hash followed the radial variation of electron temperature. An azimuthal asymmetry and rotation of the arc column were discovered which made quantitative comparison with theory difficult. Partly because of difficulties with maintaining a stable discharge over a large range of pressures and fields, this preliminary study was largely confined to a standard operating condition of 4000 gauss, 15 ampere discharge current, and 3 microns pressure. (auth)

14138 (NP-11369) THEORY OF RADIATION FROM A PULSATING PLASMA. VOLUME I. Report No. 61-2. R. C. Mack and Richard L. Moore (Moore (Richard L.) Consultants, Los Angeles). Jan. 20, 1961. 188p.

The theory is developed for electromagnetic r-f radiation from a cylindrical bounded plasma, with charge separation at its surface and whose surface has a periodic radial, azimuthal, or axial motion. The theory of plasma vibrations is treated hydrodynamically. (auth)

14139 (NP-11573) SUMMARY OF SHERWOOD ACTIVITIES. (Defense Atomic Support Agency. Field Command, Albuquerque, N. Mex.). Feb. 15, 1962. 71p.

The status of research on controlled thermonuclear reactions in Project Sherwood is summarized. Research in progress and experimental devices used at the 5 laboratories principally involved in Sherwood are described. (M C.G.)

14140 (NP-11583) PRODUCTION OF A PLASMA WITH HIGH-LEVEL PULSED MICROWAVE POWER. Technical Report 389. Thomas J. Fessenden (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Apr. 29, 1961. Contract DA 36-039-sc-78108. 53p.

A method is presented for producing a dense plasma in a resonant cavity with microwave energy. The plasma is contained in a quartz tube lying along the axis of a resonant cavity that is excited near the TE_{111} coaxial-mode resonance with 10-μsec pulses of up to 800 kw of peak power in the 10-cm band. The plasma serves as a center conductor for the coaxial mode, shifting the mode resonance near the exciting frequency. The initial transient in the plasma electron density occurs very rapidly, and the system appears to reach a steady state in less than 10 μsec. A second microwave system excites the cavity in the TE_{011} coaxial mode, which is used as a low-level probe to measure the properties of the plasma. A perturbation formula is developed that can be used to calculate the perturbing effects of the dense plasma. This formula is used to develop methods of calculating the electron density and collision frequency of the plasma by measurements of the detuning of the cavity mode. Plasma electron densities of over $10^{14}/cm^3$ are measured when over 80 kw of peak power are dissipated in the discharge. Studies are also presented of helium discharges and of light generated by the discharges. (auth)

14141 (PLR-91) PLASMA DENSITY MEASUREMENT BY NUCLEAR PARTICLE ABSORPTION METHOD. Che-jen Chen (Plasmadyne Corp., Santa Ana, Calif.). Dec. 14, 1960. 15p.

A method is described for measuring the density profile of a plasma jet by analyzing the absorption of particles such as protons or α particles in the jet. The particle beams are incident on the jet in a direction transverse to its motion. The method can be used for jet densities of 10^{-4} to 10^{-3} g/cm^3. (T.F.H.)

14142 (PPL-TR-61-18) MAGNETIC FIELD MEASUREMENTS IN A CYLINDRICAL PINCH TUBE. T. Donner and L. Aronowitz (Republic Aviation Corp., Farmingdale, N. Y.). Aug. 8, 1961. Contract AF49(638)-552. 35p. (AFOSR-1762)

Magnetic field measurements in a cylindrical linear pinch tube with probes are described. Tests are performed with a discharge current frequency of 20 kilocycles in nitrogen at an initial pressure of 0.1 mm Hg. Initial capacitor voltage is varied from 1000 to 5000 volts. The magnetic field distribution, the radial current distribution, and the current density in the pinch tube are described. The discharges are concluded to be symmetric above 2000 volts. The symmetric discharges have distinct characteristics. At the start of the discharge, current flows near the outer periphery of the pinch tube. A portion of the current concentrates in a thin shell which moves toward the axis at a high velocity. The remainder of the current flows between the rapidly advancing shell and the outer radius of the pinch tube. After the formation of the first shell a second shell may form and move toward the axis. (auth)

14143 (RAD-SR-62-11) THEORETICAL AND EXPERIMENTAL INVESTIGATION OF ARC PLASMA-GENERATION TECHNOLOGY. Quarterly Progress Report No. 6, November 1, 1961–February 1, 1962. (Avco Corp. Research and Advanced Development Div., Wilmington, Mass.). Feb. 1962. Contract AF33(616)-7578. 120p.

A summary is presented of the results obtained during the past quarter on the following: high-pressure arc operation with low-contamination electrodes, operation of plasma generators with different gases, and alternating-current arc operation. Calculations of the transport properties of hydrogen and nitrogen using a computer program were completed. Experimental data were obtained on arc characteristics and heat balance of a constricted arc 1 inch in diameter, 6 inches long, as well as ½ inch in diameter, 1, 3, and 4 inches long. Similar data were obtained from the prototype arc assembly for ¼- and ½-inch exhaust nozzle diameters. (auth)

14144 (USCEC-82-202) SURFACE WAVES ON A PLASMA-CLAD CYLINDER. Willard Van Tuyl Rusch (University of Southern California, Los Angeles. Engineering Center). Sept. 1961. Contract AF19(604)-6195. 20p. (AFCRL-903; AD-266198)

Propagation constants are computed for both axially-symmetric and hybrid surface waves on an infinite, plasma-clad, circular cylinder. These surface waves may exist only if $\omega < \omega_p/\sqrt{2}$ (ω_p is the plasma resonance frequency). If the plasma is lossless, the propagation constants are purely real, and the surface waves propagate unattenuated in the axial direction but decay exponentially in the radial direction. The phase velocity of the surface waves is less than the velocity of light in the surrounding medium. (auth)

14145 (FTD-TT-62-116) HIGH-FREQUENCY OSCILLATIONS IN A LOW-PRESSURE DISCHARGE. I. A. Savchenko and A. A. Zaitsev (Zaytsev). Translated from Vestnik Moskov. Univ., Ser. III, 16: No. 2, 19-25(Mar.-Apr. 1961). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 30168.

14146 THE PROBLEM OF CONTROLLED THERMONUCLEAR SYNTHESIS. L. A. Artsimovich. Vestnik Akad. Nauk S.S.S.R., 32: No. 1, 7-15(Jan. 1962). (In Russian)

The data on plasma physics presented at the Salzburg conference in Austria are summed up. In spite of various instabilities, plasma interaction with the walls and radiation losses, significant progress has been made. The study of a fast linear discharge (fast linear pinch) showed that neutrons and gamma-rays were formed due to accelerating processes. Rapid compression of a plasma by an increasing external magnetic field (the theta pinch) is more effective in creating a high temperature than the linear discharge. A plasma concentration of 10^{16} and a temperature of 10^3 ev have been obtained for a few microseconds (at Washington and Los Alamos) by using the theta pinch effect. The paramagnetic plasma loop idea as embodied in the Ogra, the Zeta and the Stellarator (when used with ohmic heating) is a victim of instability. The energy introduced into the plasma by electrical sources is re-emitted as radiation at low power, or is discarded to the walls at higher power. Measurement of the plasma radiation, developed at Harwell, and measurement of the energy spectrum of plasma particles, developed at Leningrad and used on Alpha, are two valuable diagnostic methods resulting from this work. The anomalous diffusion observed during ohmic heating of a plasma in "Tokomak" and in the "Stellarator" has not yet been explained. The various instabilities of magnetic mirror traps are discussed. The most puzzling question in plasma physics is the effect that various types of instabilities have on the existence of the plasma. (TTT)

14147 CAUSALITY AND THE DISPERSION FORMULAS FOR WAVES IN A PLASMA. T. Pradhan (Utkal Univ., Cuttack, India). Ann. Phys. (N. Y.), 17: 418-25(Mar. 1962).

The principle of causality, which states that the effect cannot precede the cause, is invoked to obtain the correct prescription for integrating across the pole in the dispersion formulas for the longitudinal and transverse waves in a collision-free plasma obtained by the simultaneous solution of Maxwell's electromagnetic and Boltzmann's transport equations. Conditions for growing and decaying waves are obtained from the results that follow. An analysis of the nature of the initial disturbance is given. (auth)

14148 THE INTERNATIONAL CONFERENCE ON PLASMA PHYSICS AND CONTROLLED THERMONUCLEAR REACTIONS. [A Review of Selected Papers]. E. I. Kuznetsov and E. P. Velikhov. Atomnaya Energ., 12: 101-10(Feb. 1962). (In Russian)

The Salzburg conference on the above subjects, held from September 4 to 9, 1961 was organized by IAEA; 508 delegates from 29 countries and 6 international organizations took part in the proceedings. The papers presented at the sessions and the ensuing discussion will be published in a forthcoming issue of "Nuclear Synthesis." A selection of the papers deemed most important is reviewed, presenting them under the following headings: I. Experimental studies—a. Fast processes; b. Quasistationary discharges in toroidal chambers; c. High-frequency heating methods and the confinement of the plasma; d. Magnetic traps; II. Theoretical problems. (TTT)

14149 EXCITATION OF HIGH FREQUENCY OSCILLATIONS OF ELECTRON PLASMA BY A DIVERGING BEAM. I. Štoll (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B 12: 21-5(1962). (In Russian)

Stability of high-frequency oscillations of electron plasma is investigated in the hydrodynamical approximation. The oscillations are believed to be excited by a beam of electrons emitted from a spherical or cylindrical surface. The regions of instability in the spectrum of frequencies are found, and it is shown that the amplitude of the oscillations increases as a power of the distance (in the case of spherical symmetry) or as $r^{-\frac{1}{2}} \exp r^{\frac{1}{2}}$ (cylindrical symmetry). (auth)

14150 DEVELOPMENT OF 36-MEGAWATT MODULATORS FOR THE ASTRON 1000-MEGAWATT ELECTRON ACCELERATOR. Vernon L. Smith (Univ. of California, Livermore). IRE Trans. on Nuclear Sci. NS-9, No. 2, 57-67(Apr. 1962). (UCRL-6469)

Details of the design and development of a line-type modulator used for pulsing cores and capable of an output peak power of 36 megawatts is discussed. A type 6587 and type 5949A thyratron were life-tested at 32 kv, 2000 amperes, and 60 pps. Useful life in excess of 1000 hours was obtained. In addition, it was necessary to develop corona-resistant connectors for this application. Life data and final design for a small connector suitable for operation at 16-kv, 0.4-μsec (70% amplitude points) pulses with 60-nanosecond rise time, and at 60 pps are presented. (auth)

14151 THE ENERGY STORAGE SYSTEM FOR A 3.5-MEGAJOULE MAGNETIC COMPRESSION EXPERIMENT. T. M. Putnam and E. L. Kemp (Los Alamos Scientific Lab., N. Mex.). IRE Trans. on Nuclear Sci. NS-9, No. 2, 74-82(Apr. 1962).

The Scylla experimental program has shown that a small volume of high temperature (>10^7°K) plasma can be produced by the application of a fast-rising, sinusoidal, axial magnetic field to a volume of partially ionized deuterium gas. The apparatus described was designed to produce a plasma with the same final density and temperature as in a net energy-producing plasma but for a much shorter containment time. However, the magnetic half period will be of sufficient length to allow the stability problem to be studied thoroughly. The engineering aspects of the 3.5 Mj experiment, Scylla IV, are discussed in detail. The basic problems in the design are those of minimizing the source inductance, providing electrical insulation for tens of kilovolts and providing transmission systems and switches capable of handling currents of 20 to 30 megamperes. The design of the capacitor banks, switching system, cabling and cable headers, and collector plates is described. (auth)

14152 DIAMAGNETIC PROPERTIES OF PLASMA EXCITED IN ARGON AND NEON. D. A. Pulin and V. G. Stephanov (Kirov Urals Polytechnic Inst., USSR). Izvest. Vysshikh Ucheb. Zavedenií, Fiz., No. 5, 26-9(1961). (In Russian)

A method was developed for measuring plasma magnetic susceptibility, and measurements of inert gas plasma diamagnetism was compared with theory. The magnetic susceptibility dependence on pressure was also determined. (R.V.J.)

14153 EFFECTS OF ELECTRON RANDOM MOTION ON MICROWAVE PROPAGATION THROUGH A PLASMA PARALLEL TO A MAGNETIC FIELD. Joseph E. Willett (McDonnell Aircraft Corp., St. Louis). J. Appl. Phys., 33: 898-906(Mar. 1962).

Expressions for the propagation of a circularly polarized microwave through a plasma parallel to a uniform, static magnetic field are derived from the Boltzmann equation and, alternately, from the equation of motion of an individual electron. Both methods yield the same formulation, in which effects of the random motion of the electrons are predicted to result from: the Doppler shift caused by electron motion parallel to the direction of propagation; electron free paths extending over distances significant compared to the attenuation length; and variation of collision frequency with electron velocity. The results of a numerical study of the propagation of a right-handed wave indicate that the first two of these effects are important in the region of cyclotron resonance even at moderate temperatures (e.g., in re-entry plasmas) provided that the collision frequency is small compared to the signal radian frequency. Substantial reduction of the attenuation of a right-handed wave in a plasma may be achieved by means of a magnetic field aligned parallel to the direction of propagation. The cyclotron frequency must be of the order of the signal radian frequency or larger, and selected such that the enhanced attenuation arising from the electron random motion is avoided. The effectiveness of a given magnetic field in reducing the attenuation increases with decreasing ratio of collision frequency to signal radian frequency. (auth)

14154 A NOTE ON THE PARAMETRIC AMPLIFIER THEORY FOR PLASMAS. S. F. Paik (Raytheon Co., Burlington, Mass.). J. Appl. Phys., 33: 1017-18(Mar. 1962).

The theoretical aspects of using a gas-discharge plasma as a parametric amplifier are discussed. The second-order convection currents in the plasma may be derived separately for the cases of zero and infinite axial magnetic fields. By taking into account the surface effects of the plasma, it is shown to be possible to make the calculated currents for the two magnetic field cases approach the same limit as the electric field becomes completely axial. It is noted that for many cases of practical interest, the electric field is almost completely axial. (T.F.H.)

14155 PROPAGATION OF A PLANE ELECTROMAGNETIC WAVE IN A PLASMA AT THE CUT-OFF AND BEYOND. R. Papoular (Centre d'Etudes Nucléaires, Fontenay aux Roses, France). J. phys. radium, 22: 749-58(Nov. 1961). (In French)

The complete solution of Maxwell's equations for two typical density distributions makes clear the shortcomings of the geometrical-optics hypotheses for thin plasmas. The reflection coefficient of a layer of plasma is very different from 1 unless the working frequency is lower than the nominal cut-off frequency and, the thinner the layer, the lower the frequencies. The phase lag of the reflected wave depends on the plasma thickness as well as on the working frequency. Nevertheless, in certain cases the phase lag of the transmitted wave is practically the same as that which is deduced from geometrical optics. A general relation between amplitude and phase angle of the electromagnetic field is also proved. (auth)

14156 VISCOSITY COEFFICIENT OF A PLASMA IN A MAGNETIC FIELD. Shobu Kaneko (Tokyo Univ.). J. Phys. Soc. Japan, 17: 390-2(Feb. 1962). (In English)

The convergence of Chapman-Enskog's approximation to the viscosity coefficient of a plasma is examined by calculations up to the 4th approximation. The viscosity coefficient in the 2nd approximation has sufficient accuracy for practical purposes, its error being 5% at most. (auth)

14157 MICROWAVE GENERATION OF THE SECOND HARMONIC IN A PLASMA. Makoto Moriyama and Masao Sumi (Electrical Communication Lab., Tokyo). J. Phys. Soc. Japan, 17: 397(Feb. 1962). (In English)

The second harmonic density was obtained considering the time dependency of the electron density and using the electron distribution function under a microwave field. The current-density expression is derived, and gas-temperature effects are neglected. Ramsauer effects on harmonic generation may be considered using the final equation. (L.N.N.)

14158 BREAKDOWN CONDITION IN AN AZIMUTHAL DISCHARGE. Taijiro Uchida, Haruyuki Ohnishi, and Masatomo Sato (Nihon Univ., Tokyo). J. Phys. Soc. Japan, 17: 399-400(Feb. 1962). (In English)

The condition of the gas breakdown is investigated. Two distinct types were found. One is accompanied with a full production and subsequent contraction of plasma; in the other are glow discharges without the full plasma production. The former was observed by photomultiplier measurement of the light intensity, high-speed camera observation of the plasma contraction, and the particular deviation and enhanced decay rate of the voltage oscillogram from the natural one. (L.N.N.)

14159 ON THE STABILITY OF A MAGNETICALLY COMPRESSED PLASMA SURFACE. Masatomo Sato (Nihon Univ., Tokyo). J. Phys. Soc. Japan, 17: 406-7(Feb. 1962). (In English)

An attempt to show that the occurrence of Rayleigh-Taylor (R-T) instabilities depends on the magnitude of the initial rising rate of the magnetic field, $\dot{B} = (dB/dt)$, if other experimental conditions are the same, is presented. The inertia force driving instability and the resistive damping decrease, in effect, with increasing $\dot{B}$. The absence of instabilities is due to lower values of $\dot{B}$. Data are presented in tabular form, and discrepancies are discussed. (L.N.N.)

14160 INFLUENCE OF VISCOSITY, FLUID CONDUCTIVITY, AND WALL CONDUCTIVITY IN THE MAGNETOHYDRODYNAMIC RAYLEIGH PROBLEMS. Arthur E. Bryson and Jan Rościszewski (Harvard Univ., Cambridge, Mass.). Phys. Fluids, 5: 175-83(Feb. 1962).

A semi-infinite mass of incompressible, viscous, electrically conducting fluid is bounded by an infinite plane wall with a constant-strength magnetic field perpendicular to the wall. Either the wall motion is changed indicially parallel to its surface or a constant current is discharged parallel to the surface. The fluid motion and induced magnetic field are discussed for the ratio of kinematic viscosity to magnetic diffusivity, ϵ small compared to one and equal to one. For $\epsilon \ll 1$, it is shown that for the indicial motion of a perfect conductor or for a current discharge there exists a thin viscous boundary layer at the wall; the

diffusing Alfvén wave region extends outside this layer. (auth)

14161 DYNAMICAL PRINCIPLE OF STABILITY FOR MAGNETOHYDROSTATIC SYSTEMS. B. A. Trubnikov (Kurchatov Inst. for Atomic Energy, Academy of Sciences, Moscow). Phys. Fluids, 5: 184-91(Feb. 1962).

The stability of an arbitrary system is ordinarily determined by means of the variation in its potential energy produced by a displacement of the system from the equilibrium position. In some cases, however, the investigation of stability may be more convenient if it is based on the variation in kinetic energy during a motion of the system past the equilibrium position. It is shown that for magnetohydrodynamic systems such a dynamical method enables one to obtain a stability criterion equivalent to the well-known energy principle for the stability of such systems. The proposed method also permits derivation of the criterion of Kruskal and Oberman, who investigated the stability of a plasma on the basis of the kinetic equation in the limit as $(m/e) \rightarrow 0$. In this connection it turns out to be superfluous to require the various constants of the motion [of the form $\int dv\, dV\, G(L, \mu, f)$] to be equal to their equilibrium values, as Kruskal and Oberman did. (auth)

14162 ON THE NECESSITY OF THE ENERGY PRINCIPLE OF KRUSKAL AND OBERMAN FOR STABILITY. Russell Kulsrud (Princeton Univ., N. J.). Phys. Fluids, 5: 192-5(Feb. 1962). (MATT-96)

Kruskal and Oberman have developed an energy principle for stability of hydromagnetic systems in which it is assumed that the particles move adiabatically in the magnetic field. They established the sufficiency of the energy principle but left the necessity an open question. Newcomb has established the necessity of a slightly different principle which takes into account charge neutrality. He shows that the stability equations may be written in a self-adjoint form. A simpler proof is now given which is based on the conservation of energy so that it is not necessary to establish the self-adjointness by an explicit calculation. The proof is the direct analog of that given by Bernstein, Frieman, Kruskal, and Kulsrud on an energy principle for stability from the fluid equations. In both the proof first given by Newcomb, and the present one, the assumption is made that the geometry is not toroidal, but that the particles are trapped in a magnetic field as far as their longitudinal motion is concerned. (auth)

14163 TWO-STREAM INSTABILITY IN FINITE BEAMS. E. A. Frieman (Princeton Univ., N. J.), M. L. Goldberger, K. M. Watson, S. Weinberg, and M. N. Rosenbluth. Phys. Fluids, 5: 196-209(Feb. 1962).

The streaming instabilities of a finite beam of charged particles passing through a zero-temperature plasma are studied. It is shown that there are no eigenmodes associated with the instabilities. Nevertheless, by constructing wave-packet disturbances one is led to instabilities similar to those for a beam of infinite extent. (auth)

14164 EFFECT OF CHARGE EXCHANGE ON THE CRITICAL CURRENT FOR THE ONSET OF ION-WAVE INSTABILITIES. Ira B. Bernstein and Russell M. Kulsrud (Princeton Univ., N. J.). Phys. Fluids, 5: 210-12(Feb. 1962). (MATT-97)

Experimental results on the afterglow in the stellarator indicate that upon passage of an electrical current through the plasma rapid diffusion sets in at a certain critical current. This critical current can be computed theoretically and is found to depend in significant fashion on the tail of the ion distribution function. This tail may well be non-Maxwellian due to charge exchange with neutrals. The ion distribution function is computed by solving the Fokker-Planck equation, and it is found that the tail may be suppressed if there are sufficient neutrals present. This distorted distribution is then used to predict a new critical current for ion-wave instabilities. The calculations are presented in a form for easy comparison with experiment. (auth)

14165 KINETIC EQUATION FOR A CLASSICAL PLASMA. Charles R. Willis (Boston Univ.). Phys. Fluids, 5: 219-27(Feb. 1962).

The behavior of a fully ionized plasma of nonrelativistic electrons (neutralized by a background of positive charge) which is slightly disturbed from equilibrium is treated by a method that exploits the electron-electron correlations that are present in equilibrium to provide both a short- and long-distance cutoff, and to provide a damping mechanism that dominates the usual Landau damping at small k. To obtain a closed set of equations for the deviations from equilibrium of the one- and two-particle distribution functions a product assumption is made for the deviation from equilibrium of the three-particle distribution function. It is shown that the nonlinear correlations present in the rigorous pair distribution function are sufficient to derive the linearized Fokker-Planck equation. The electron-electron correlations in equilibrium are shown to give rise to a damping of plasma oscillations at long wavelength that dominates the Landau damping which is also present. (auth)

14166 STRUCTURE OF WEAK SHOCK WAVE IN A PLASMA. Yun-Chow Whang (Univ. of Florida, Gainesville) and Chieh-Chien Chang. Phys. Fluids, 5: 228-33(Feb. 1962).

The structure of a weak shock wave in a fully ionized plasma is studied by using Grad's thirteen-moment approximation to the nonequilibrium distribution functions for both ions and electrons. The flow field in the transition region is described by equations of transfer which are obtained by taking moments of the Boltzmann equation. Under the assumption of no charge separation, the basic equations are reduced to a pair of nonlinear differential equations. Many numerical solutions are obtained. A simple method of estimating the order of magnitude of shock thickness is given. It is established that shock profiles are thicker than those corresponding to the continuum theory, although they are of the same order of magnitude. (auth)

14167 WAVE MOTIONS OF SMALL AMPLITUDE IN A FULLY IONIZED PLASMA UNDER APPLIED MAGNETIC FIELD. S. I. Pai (Univ. of Maryland, College Park). Phys. Fluids, 5: 234-40(Feb. 1962).

Wave motions of infinitesimal amplitude in a fully ionized plasma, consisting of singly charged ions and electrons, were investigated by a two-fluid theory under uniform external magnetic field. The interaction of the basic modes of wave from external magnetic field was discussed. If the magnetic field is in the direction of propagation of the waves, two basic transverse waves interact, if the magnetic field is perpendicular to the direction of propagation of waves, two basic longitudinal waves and one basic transverse wave will interact, and if the direction of the magnetic field is at an acute angle with the direction of the propagation, all four basic waves will interact. The dependences of the interacted waves on ion and electron plasma frequencies and ion and electron cyclotron frequencies are analyzed in detail. The effect of finite electrical conductivity on these waves is briefly discussed. (auth)

14168 THEORETICALLY STABLE AND CONFINED PLASMA. T. K. Fowler (Oak Ridge National Lab., Tenn.). Phys. Fluids, 5: 249-50(Feb. 1962).

Certain distributions of plasma confined in a potential well are stable against a growth of space charge, as governed by the linearized Vlasov-Boltzmann equation with only Coulomb interactions between particles. It is shown that these same distributions remain stable when magnetic as well as electrostatic forces between particles are admitted. Short-range collisions and retardation effects are neglected. The plasmas proven stable are those in which the equilibrium distribution functions are functions of the equilibrium energy. Stellar plasmas bound by their self-gravitational field are examples. (N.W.R.)

14169 PLASMA WITH NET CHARGE. J. L. Jackson, D. B. Levine, and R. A. Piccirelli (National Bureau of Standards, Washington, D. C.). Phys. Fluids, 5: 250-1 (Feb. 1962).

Calculations are presented which point out that the Vlasov equation does not conserve entropy in the presence of a net charge. It is found that accompanying the particle flow there is a corresponding entropy flow. An elementary physical explanation of the results is a consequence of the fact that the presence of the net charge in an infinite plasma sets up current at infinity. (N.W.R.)

14170 LARGE-AMPLITUDE MAGNETIC COMPRESSION OF A COLLISION-FREE PLASMA. II. DEVELOPMENT OF A THERMALIZED PLASMA. P. L. Auer, H. Hurwitz, Jr., and R. W. Kilb (General Electric Research Lab., Schenectady, N. Y.). Phys. Fluids, 5: 298-316(Mar. 1962).

Numerical calculations are made of a strong one-dimensional disturbance traveling perpendicular to a magnetic field in a fully ionized and collisionless plasma. When the Alfvén-Mach number M_h is greater than 2, orbit crossings of the ions occur, which rapidly leads to thermalization perpendicular to the magnetic field if the crossings are extensive ($M_h > 3$). The thermalization approximates the behavior of a classical hydromagnetic shock, with a shock-front thickness roughly equal to the distance the shock front travels in one-half an ion gyration time. This length is somewhat greater than the ion gyration radius. The structure of the front is found to be strongly time dependent, and undergoes large fluctuations in an ion gyration period. It is argued that when the ion-electron mass is large, the magnetic forces tend to suppress electron orbit crossings. This results in relatively cold electrons in the shocked region, with the ions obtaining nearly all of the thermal energy. A relationship between the longitudinal electrostatic potential difference across the shock front and mass flow in the plane of the front is derived on the basis of a simplified model and is found to be in qualitative agreement with the numerical results. The range of applicability of the calculations to real plasmas is discussed. (auth)

14171 PAIR CORRELATION IN A PLASMA. P. A. Wolff (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Fluids, 5: 316-21(Mar. 1962).

A technique due to Dupree is used to investigate the pair correlation function in a dilute, uniform, quiescent plasma. It is demonstrated that his formal expression for the pair function may be evaluated in many cases of physical interest. In equilibrium one obtains the usual Debye-Hückel result, which may be generalized to the case of a plasma having different temperatures in different directions. A Lorentzian-type velocity distribution gives rise to a correlation function containing less than unit screening charge. It is shown that such behavior is only to be expected for velocity distributions that approach zero rather slowly in the limit of large velocity. Finally, a Druyvesteyn-type distribution is investigated and shown to lead to a pair function that falls off somewhat more slowly, and has a different form, from that of the Debye-Hückel theory. (auth)

14172 KINETIC EQUATION FOR A COMPLETELY IONIZED GAS. Ralph L. Guernsey (Boeing Scientific Research Labs., Seattle). Phys. Fluids, 5: 322-8(Mar. 1962).

Previous derivations of the kinetic equation for a completely ionized gas have proceeded under the following assumptions: the system is spatially uniform, and sufficient time has elapsed so that the higher distribution functions depend on time only through the one-particle distribution. A kinetic equation is derived which is not subject to these restrictions, and is valid for any system not too far from equilibrium. (auth)

14173 INSTABILITY OF CONTRASTREAMING PLASMAS WITH RESONANCE DISTRIBUTION FUNCTIONS. F. Ek, S. L. Kahalas, and D. A. Tidman (Allied Research Associates, Inc., Boston). Phys. Fluids, 5: 328-33(Mar. 1962).

An analysis is made of the instability of waves in contrastreaming plasmas. The unperturbed distribution function, which occurs in the dispersion relation, is taken to be a resonance function of the form $f_0(v) = \text{const}\ (v^2 + V^2)^{-3}$, where V is related to the thermal velocity. This function has the dual advantage of allowing the computation of physical properties such as energy and of yielding a dispersion relation amenable to numerical analysis in important cases. The case of identical contrastreaming plasmas is analyzed in two phases: an electron instability which may arrest the streaming motion and an electron-ion instability involving the static, heated electrons and the ion streams. Critical temperatures for these instabilities are determined and compared with results obtained from Maxwellian distribution functions. Stability criteria for arbitrary temperatures are obtained with the resonance function. Growth rates over the band of allowed wave numbers are given for both phases of instability. (auth)

14174 ANOMALOUS DIFFUSION OF A PLASMA ACROSS A MAGNETIC FIELD. S. Yoshikawa and D. J. Rose (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 5: 334-40(Mar. 1962).

The diffusion of a plasma across a magnetic field is considered both theoretically and experimentally. It was found out that the fluctuation of the density can cause an anomalous diffusion that is inversely proportional to the magnetic field B. The mobility of electrons perpendicular to the magnetic field was measured in the experiment; the measurement supports 1/B diffusion. The density fluctuation was also measured. There is good agreement between the observed mobility and the theoretical one derived from the density fluctuation. The potential fluctuation was found to be an increasing function of the external potential and independent of the magnetic field intensity. This fact also indicates that fluctuation or turbulence plays an important role in the anomalous diffusion. (auth)

14175 CURRENT SHEET IN A COAXIAL PLASMA GUN. L. C. Burkhardt and R. H. Lovberg (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 5: 341-7(Mar. 1962).

Magnetic- and electric-probe measurements were made on the thin current layer which is accelerated in a coaxial (Marshall) plasma gun. It is found that this layer does not act as a snowplow, but rather has the character of a strong shock wave. (auth)

14176 MACROSCOPIC INSTABILITY OF THE POSITIVE COLUMN IN A MAGNETIC FIELD. George A.

Paulikas and Robert V. Pyle (Univ. of California, Berkeley). Phys. Fluids, 5: 348-60(Mar. 1962). (UCRL-9682)

The positive column of a glow discharge was previously shown to become unstable when immersed in a longitudinal magnetic field of the order of 1 kgauss, the instability transforming the azimuthally symmetric column into a constricted rotating helical stage. The measurements were extended, with emphasis on the properties and growth of the instability, to permit a quantitative comparison between experiment and the theory of Kadomtsev and Nedospasov. The properties of the helical state were measured in H_2, D_2, He, and Ne as functions of gas pressure and tube radius. The dependence of the critical magnetic field, and the frequency and wavelength of the oscillation on the kind of gas, pressure, and the tube radius are in fairly good agreement with the predictions made by the perturbation theory of Kadomtsev and Nedospasov. It is interesting that the onset of the instability is also fairly well predicted by the simple sheath-instability theory of Hoh, but the agreement is not as good as in the previous case, nor is the nature or appearance of the instability specified. (auth)

14177 ADIABATIC ACCELERATION OF IONS BY ELECTRONS. H. W. Hendel and T. T. Reboul (Radio Corp. of America, Princeton, N. J.). Phys. Fluids, 5: 360-2 (Mar. 1962).

The velocities and angular distributions of different plasmas ejected from pulsed low-voltage (37 v) discharges were measured. Velocities of metal-plasmas greater than 10^6 cm/sec were observed. Probe measurements of the initial electron temperature (≈25 ev) in the discharge and measurements of the final electron temperature (≈1 ev) in the drifting plasma are taken as evidence for an acceleration of the ions by the space charge set up by the initially more energetic electrons. The angular distribution of the ejected plasma was isotropic and the plasma velocity was inversely proportional to the square root of the ion mass, in agreement with the theoretical explanation. (auth)

14178 CONVECTIVE PLASMA INSTABILITY. Arthur F. Kuckes (Princeton Univ., N. J.). Phys. Fluids, 5: 363-4(Mar. 1962). (MATT-94)

The current convective plasma instability theory of Kadomtsev and Nedospasov was extended to highly ionized plasma in very strong magnetic fields. The growth of plasma density fluctuations predicted is discussed with regard to the enhanced diffusion observed in stellarator experiments. (auth)

14179 ATTRACTIVE TWO-BODY INTERACTIONS IN PARTIALLY IONIZED PLASMAS. Gilda M. Harris (Univ. of California, Livermore). Phys. Rev., 125: 1131-40 (Feb. 15, 1962). (UCRL-6486-T)

It has recently been shown that in a classical plasma a shielded Coulomb (Yukawa) potential describes the effective two-particle interactions through chains of intermediate particles. It therefore seemed reasonable to use this potential to approximate two-particle quantum interactions in a sea of charged particles, such as a hydrogen plasma. Consequently, an approximate solution of the Schrödinger equation was obtained for a hydrogen atom in a shielded Coulomb potential. With this potential, the number of H-atom bound states is finite and the energy eigenvalues are a function of the density and temperature. A variational calculation was performed using hydrogen-like single electron functions as a basis set and the effective nuclear charge as a variational parameter. Bound-state energies were obtained for 45 states of hydrogen in a grid of values for the screening constant. As the screening increases, the bound-state energy increases. For each state there is a maximum shielding above which the state is free, i.e., for which $E > 0$. According to the present calculation, the energy of the ground state becomes zero at a screening of 1.15 atomic units. Above this value then, no bound states can exist. (auth)

14180 NONLINEAR INTERACTION OF AN ELECTROMAGNETIC WAVE WITH A PLASMA LAYER IN THE PRESENCE OF A STATIC MAGNETIC FIELD. II. HIGHER HARMONICS AND A NONLINEAR PROPAGATION THEORY. R. F. Whitmer and E. B. Barrett (General Telephone and Electronics Labs., Palo Alto, Calif.). Phys. Rev., 125: 1478-84(Mar. 1, 1962).

A discussion is given of the properties of the third- and fourth-harmonic waves generated within a plasma layer. The conversion loss for the hth harmonic is presented. Conditions for the validity of the small-signal analysis are derived. Also, a technique for using the harmonics as a means of measuring the plasma parameters is presented. A method is given for reiterating the general solution for the field at the hth harmonic. This reiteration procedure extends the range of validity of the small-signal analysis and also allows the determination of a correction to the field at the fundamental frequency. This correction takes into account the effects of the nonlinear terms, in the Boltzmann transport equation, on propagation phenomena. A discussion is given of the corrected field as a function of the plasma parameters. Under certain conditions the correction can be as large as 50%. (auth)

14181 OBSERVATION OF CRITICAL FLUCTUATIONS ASSOCIATED WITH PLASMA-WAVE INSTABILITIES. S. Ichimaru (Univ. of Illinois, Urbana), D. Pines, and N. Rostoker. Phys. Rev. Letters, 8: 231-3(Mar. 15, 1962).

Possibilities of utilizing electromagnetic wave scattering to observe the onset of plasma-wave instabilities associated with electron drift versus ions under actions of applied electric fields in fully ionized plasma are discussed. As the plasma approaches from a region of stability, a critical point corresponding to the onset of an instability is predicted, in which enormously enhanced electromagnetic radiation scattering occurs at certain angles. Mathematical calculations are presented, and results are given in graphical form. (L.N.N.)

14182 INTERFEROMETRIC MEASUREMENTS OF THE ELECTRON DENSITY IN A SHOCK HEATED DEUTERIUM PLASMA. J. K. Wright, R. D. Medford, A. G. Hunt, and J. D. Herbert (Atomic Weapons Research Establishment, Foulness, Essex, Eng.). Proc. Phys. Soc. (London), 78: 1439-48(Dec. 15, 1961).

First results of experiments new to plasma research are reported, namely time-resolved interferometry in the optical region. It is shown how the electron density distribution of a fast cylindrical pinched discharge may be measured and how the physical conditions in the discharge may be deduced. (auth)

14183 SPECTROSCOPIC INVESTIGATIONS OF PLASMA CONTAINMENT IN ZETA. W. M. Burton and R. Wilson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 78: 1516-38(Dec. 15, 1961).

Observations are made of the time variation of intensities of spectral lines emitted by small quantities of impurity ions in a deuterium discharge in ZETA. A vacuum ultraviolet monochromator which covers the wavelength range 500 to 2000 Å is used. Observations are interpreted in terms of temporal ionization distributions determined for a partially contained plasma model. The observations are

consistent with the model, and it is shown that plasma containment in ZETA is violated by an escape of plasma to the wall represented by a loss rate coefficient $\lambda(sec^{-1})$, and an injection of atoms in a neutral or low state of ionization represented by an injection coefficient $\Lambda(sec^{-1})$. The value of λ is effectively independent of the stabilizing magnetic field strength B_z, whereas the injection coefficient varies considerably with this parameter. Both λ and Λ are closely correlated with ϵ, the energy input per unit mass of gas, and over the range of conditions investigated they show a linear increase with ϵ. The ion containment time $1/\lambda$ is about 100 μsec at ϵ = 3 kev/m_p, and at this condition most of the energy input is carried to the walls by the escaping plasma. The net effect of the processes of loss and injection controls the variation of plasma line density, and, in general, this shows a decrease with time or "pump-out." This is measured and related to other discharge phenomena. (auth)

14184 NOTES ON THE EFFECT OF NOISE ON LANGMUIR PROBE CHARACTERISTICS. A. Garscadden and K. G. Emeleus (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 79: 535-41(Mar. 1, 1962).

A partial analysis was made of the effects of fluctuations in a plasma on the data obtained by conventional use of Langmuir probes. Consideration was given to effects of periodic fluctuations of electron temperature, random current, and space-potential, supposed independent of probe potential. For a wide range of conditions, the values of electron temperature obtained will be correct, but values of electron concentration underestimated. Experiments are described to check part of the theory, and the bearing of the experimental and theoretical results obtained on the probe analysis of discharges in which there are plasma electron oscillations is discussed briefly. (auth)

14185 ON THE EXCITATION MECHANISM OF ELECTRON PLASMA OSCILLATIONS. M. D. Gabovich (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Radiotekh. i Elektron., 6: 178-9(Jan. 1961). (In Russian)

The theory of electron spatial interaction with plasma is analyzed, and the I. Merill and W. Webb proposal of a klystron-type oscillation excitation mechanism is confirmed. (R.V.J.)

14186 ATTENUATION OF SLOW ELECTROMAGNETIC WAVES IN A PLASMA ROD IN A LONGITUDINAL MAGNETIC FIELD. V. P. Shestopalov and I. P. Yakimenko (Khar'kov State Univ.). Radiotekh. i Elektron., 6: 653-4 (Apr. 1961). (In Russian)

Dispersion equations were derived for a plasma column in the presence of a longitudinal magnetic field. Wave dispersion and attenuation for $3\omega_H a/c = 0.1$, $\delta = 10^{-3}$ (where ω_H = frequency, a = radius of plasma column, and c = light velocity) are found. The curves indicate a slowing down order of 10 to 20 at 0.1 $\partial\sigma$/cm. (R.V.J.)

14187 PLASMA MOVEMENT IN CROSSED ELECTRICAL AND MAGNETIC FIELDS. A. K. Musin. Radiotekh. i Elektron., 6: 770-8(May 1961). (In Russian)

Special cases of plasma motion in intersecting electric and magnetic fields in stationary or non-stationary states are studied with consideration for viscosity. Formulas were derived and diagrams are plotted for describing the rate of motion as a function of the external magnetic field magnitude. The inducted saturation of the rate in a strong magnetic field is discussed. (tr-auth)

14188 THE EQUATIONS OF PLASMA DYNAMICS. A. Koller (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Z. Physik, 166: 265-74(1962). (In German)

The equations of plasma dynamics derived by several authors show slight differences. It is demonstrated that the reason for this is the application of different approximate solutions of the Boltzmann equation. (auth)

14189 PROPAGATION OF ELECTROMAGNETIC WAVES IN PLASMA. Yu. N. Dnestrovskii and D. N. Kostomarov. Zhur Vychislitel'. Mat. i Mat. Fiz., 2: No. 1, 97-107(Jan.-Feb. 1962).

The propagation of electromagnetic waves in a magnetoactive plasma in a direction perpendicular to a homogeneous external magnetic field was studied. The propagation of such waves in the plane case is described by a linearized system of Maxwell equations, which is reduced to two independent systems of integro-differential equations containing the components $\{E_x, E_y, E_z, H_y, H_z\}$ of electric and magnetic fields. By using the method of best approximations, theorems are proved of the existence and uniqueness of solutions $\{E_x, E_y, H_z\}$ for the first system and $\{E_z, H_y\}$ for the second. Upper bounds for the solutions are established and the behavior of solutions at the initial phase of the process is studied. For the study of solutions when $t \to \infty$, the method of integral transformations (Laplace, Fourier) is used to obtain solutions in an explicit form. This method is applied to the solution of two problems: excitation of electromagnetic waves in plasma by transverse currents $j^{(\omega)}(t,x)$, which are harmonic time functions, and $j^{(\omega)}(t,x) \equiv 0$, but initial perturbations are given. (OTS)

14190 MAGNETO-FLUID-DYNAMICS. Current Papers and Abstracts. L. G. Napolitano and G. Contursi, eds. AGARD Bibliography I. Enlarged Edition. New York, Pergamon Press, 1962. 268p. $10.00.

A partially annotated bibliography is presented, consisting of 2038 references to material on magneto-fluid-dynamics. Author, journal and institution, and subject indexes are included. (T.F.H.)

14191 UPRAVLYAEMYE TERMOYADERNYE REAKTSII. (Controlled Thermonuclear Reactions). L. A. Artsimovich. Moscow, State Publishing House of Literature on Physics and Mathematics, 1961. 467p.

Theoretical concepts and various processes in plasma are analyzed. Methods of plasma heating and thermal isolation and installations for handling high-temperature plasma are described. The first four chapters are concerned with plasma physics (particle motion, transfer phenomena, and magnetohydrodynamics of plasma); the last four chapters are concerned with experimental studies related to thermonuclear synthesis. 128 references are included. (R.V.J.)

14192 THERMONUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 891,727. Mar. 21, 1962.

A pyrotron-type machine is designed for carrying out thermonuclear reactions. Loss of charged particles is minimized by reflecting them in an axially symmetrical magnetic field with an a-c electric field applied transversely to the magnetic field. (D.L.C.)

14193 ELECTRIC DISCHARGE APPARATUS. Thomas M. Ryan (to U. S. Atomic Energy Commission). U. S. Patent 3,028,517. Apr. 3, 1962.

A steel or aluminum small diameter ($^1/_4$ in.) tube-type neutron detector containing an inert atmosphere and having a coating of fissionable material on its inner circumference is described. A conducting wire, positioned along the axis of the tube by spaced insulators, is connected to a

power source. The coating of fissionable material is brushed onto a nickel foil which is inserted into the tube and supported between the insulators. (AEC)

14194 PLASMA DEVICE. William R. Baker, Alexander Brathenahl, and Harold P. Furth (to U. S. Atomic Energy Commission). U. S. Patent 3,029,199. Apr. 10, 1962.

A device for producing a confined high temperature plasma is described. In the device the concave inner surface of an outer annular electrode is disposed concentrically about and facing the convex outer face of an inner annular electrode across which electrodes a high potential is applied to produce an electric field therebetween. Means is provided to create a magnetic field perpendicular to the electric field and a gas is supplied at reduced pressure in the area therebetween. Upon application of the high potential, the gas between the electrodes is ionized, heated, and under the influence of the electric and magnetic fields there is produced a rotating annular plasma disk. The ionized plasma has high dielectric constant properties. The device is useful as a fast discharge rate capacitor, in controlled thermonuclear research, and other high temperature gas applications. (AEC)

14195 METHOD AND APPARATUS FOR TRAPPING IONS IN A MAGNETIC FIELD. John S. Luce (to U. S. Atomic Energy Commission). U. S. Patent 3,030,543. Apr. 17, 1962.

A method and apparatus are described for trapping ions within an evacuated container and within a magnetic field utilizing dissociation and/or ionization of molecular ions to form atomic ions and energetic neutral particles. The atomic ions are magnetically trapped as a result of a change of charge-to-mass ratio. The molecular ions are injected into the container and into the path of an energetic carbon arc discharge which dissociates and/or ionizes a portion of the molecular ions into atomic ions and energetic neutrals. The resulting atomic ions are trapped by the magnetic field to form a circulating beam of atomic ions, and the energetic neutrals pass out of the system and may be utilized in a particle accelerator. (AEC)

14196 STABILIZED PINCH MACHINE. Oscar A. Anderson (to U. S. Atomic Energy Commission). U. S. Patent 3,031,396. Apr. 24, 1962.

A device for heating and confining a high temperature gas or plasma utilizing the linear pinch effect is described. The pinch discharge produced is the form of an elongated cylinder. The electrical discharge current is returned in parallel along an axial and a concentric conductor whereby the magnetic field of the conductors compresses and stabilizes the pinch discharge against lateral instability. (AEC)

14197 HIGH ENERGY GASEOUS PLASMA CONTAINMENT DEVICE. James L. Tuck (to U. S. Atomic Energy Commission). U. S. Patent 3,031,398. Apr. 24, 1962.

A plasma containment device is described. The device has means for producing a magnetic field region having a zero intensity in its interior, an intensity greater than a critical value B_c at all points along its border except a small jet entrance cusp, and a value less than B_c at the entrance cusp. There are means for directing a high velocity plasma jet at the entrance cusp. The critical magnetic field intensity B_c is defined by the relation. $B_c^2 = 12\pi\rho_0 v_0^2$, where ρ_0 = the density of the plasma as it leaves the accelerator, and v_0 = the plasma velocity at such time. (AEC)

Shielding

14198 (APEX-153) EFFECT OF ALTITUDE AND FLIGHT SPEED ON SHIELDING REQUIREMENTS. W. E. Edwards (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 15, 1954. Contract AT(11-1)-171. 16p.

Estimated shield thicknesses and weights for reactor and crew compartment are reported for wiggly-ducted AC-1 and AC-2 power plants operating under the assumed flight conditions of M = 0.9 at sea level, 20,000, 40,000, and 60,000 feet and M = 2.0 at 20,000, 40,000, and 60,000 feet. The effect of reduced air density on air-scattered radiation and the effect of reduced reactor power were considered in these calculations. The reactor side alkylbenzene thickness was adjusted in every case to maintain approximately the same maximum neutron flux at the reactor shield surface as was obtained at the shield surface of the AC-1 operating at M = 0.9 at sea level. All other shield reductions were made at the crew compartment. Typical of the results was a decrease in the total engineered weight of the reactor-shield assembly plus the weight of shielding for a specific three-man crew compartment from a value of 59,100 pounds at sea level to 41,300 pounds at 60,000 feet altitude for the AC-1 operating at M = 0.9. (auth)

14199 (DC-57-4-67) ELECTRON LEAKAGE FROM ALUMINUM AND WATER SPECIMENS IRRADIATED WITH 1 MEV GAMMA RAYS. J. R. Beeler, Jr. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). March 31, 1957. Contract AT(11-1)-171. 33p.

The ratio of the total kinetic energy K_e of all secondary electrons which escape from a slab irradiated by a normally incident γ-ray beam to the energy, Γ, transferred from the beam to Compton electrons is estimated. Experimental results on the transmission of monochromatic, collimated electron beams through foils are used to formulate a transmission factor for Compton electrons initiated in a slab by Compton scattering and their progeny. The estimate obtained is $K_e/\Gamma = 0.02(1/t + \tau/10)$ where t is the slab thickness in cm. and τ is the total Compton cross-section for the average energy of the residual photon in a first order Compton scattering. This result is valid for materials "in the range" between water and aluminum (density between 1 and 3) and for primary photon energies at 0.75 Mev to 2.0 Mev. (auth)

14200 (DC 61-1-101) INTERIM REPORT ON THE ANALYSIS OF GAMMA RAY POINT SOURCE DATA FROM SINGLE MATERIAL MEASUREMENTS. V. J. Mitchell (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). January 27, 1961. Contract AT(11-1)-171. 30p.

Data from gamma ray point source experiments with water and tin using Cs^{137} and Co^{60} sources are reported, and the data were reduced to buildup factors for comparison with moments method calculations of dose buildup factors. The disagreement between theory and experiment evident with previous point source data exists in this analysis. Agreement of theory with experiment was improved by comparison with computed energy absorption buildup factors for anthracene (instead of comparison with dose buildup factors). These results indicate the need for additional measurements. In addition, a satisfactory first attempt comparison between a computed pulse height distribution and an experimental distribution taken behind an Fe disc using a Cs source is presented. (auth)

14201 (DC 61-4-15) OTT LAMINATED-SHIELD CONFIGURATION ANALYSIS METHOD. J. A. Belcher and L. K. Zoller (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 20, 1960. Contract AT(11-1)-171. 58p.

The analytical method used in the evaluation of the laminated-shield (slab) configurations tested in the General Electric Outside Test Tank (OTT) is described. A discussion of the IBM-704 computer program input data is included along with a compilation of nuclear data for the various materials used in the experimental studies. It is anticipated that the analysis of these experimental data will provide information for the development or improvement of other analytical methods and techniques. (auth)

14202 (NARF-61-41T) THE APPLICATION OF INVARIANT IMBEDDING TO SHIELDING PROBLEMS. R. E. Beissner (General Dynamics Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Mar. 9, 1962. Contract AF 33(600)-7201. 71p. (MR-N-287)

The fundamental concepts of the theory of invariant imbedding as applied to particle transport processes are reviewed and their applications to shielding problems are discussed. Two new approximate methods for predicting the transmission of particles through slabs of material are derived from the imbedding equations. One-velocity computations of the angular distributions of particles reflected and transmitted by slabs of varying thickness and composition are presented and analyzed. (auth)

14203 (NARF-62-1T) NEUTRON AND GAMMA AIR SCATTERING AND AIR SECONDARY TRANSFER FUNCTIONS FOR SHIELDING APPLICATIONS. C. E. Humphries and N. D. King (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Mar. 9, 1962. Contract AF33(657)-7201. 409p. (MR-N-283)

Air transfer functions were determined for several important types of interactions: air scattering of gamma rays and neutrons, production of gamma rays by capture of neutrons, and production of gamma rays by inelastic scattering of neutrons. Attenuation through selected combinations of shielding materials is considered in these functions. Equations are given for calculating the dose rate inside a shielded compartment due to air-scattered gammas, air-capture gammas, gammas produced by inelastically scattered neutrons in air, and air-scattered neutrons. The air transfer functions, $P(\alpha,E,t_1,t_2)$, used in the dose-rate equations were reproduced from the IBM output, and appear as tables. Each set of functions listed in these tables was computed for one air density and one separation distance. To obtain functions for other conditions, the data can be extrapolated. (auth)

14204 (TID-14973) UNCOLLIDED FLUX FROM FINITE RIGHT-CIRCULAR CYLINDER VIEWED ENDWISE. J. R. Fagan and Larry A. Rash (Kansas State Univ., Manhattan. Engineering Experiment Station). Dec. 1961. 66p.

Empirical techniques are presented for use in determining the centerline uncollided neutron or gamma flux from the end of finite cylinders without computer aid. (auth)

14205 APPLICATION OF MULTIGROUP METHODS FOR COMPUTING A BIOLOGICAL SHIELD. D. L. Broder, A. P. Kondrashov, A. A. Kutuzov, V. A. Naumov, Yu. A. Sergeev, and A. V. Turusov. Atomnaya Energ., 12: 129-39(Feb. 1962). (In Russian)

The applicability of methods for calculating biological shields of heavy- and light-water reactors was examined. The methods involved the determination of the spatial distribution and the energy spectrum of neutrons at distances up to 40 cm from the source by means of a 10-group and 7-group calculation with diffusion and Fermi-age approximation, respectively. The methods are of special interest for elastic processes with energies exceeding 1 Mev, and for isotropic inelastic scattering or for cases in which the nonisotropic character of the elastic scattering may be computed by introducing the transport scattering cross section. Results of measurements carried out by the activation of Cu foils agreed well with both the 7-group calculations based on the semi-empirical definition of fast neutrons and the 10-group method. The methods were found to be suitable for B-containing media, within the 20% limit. No direct confirmation has been obtained that the 7-group method is more precise as for the shielding thicknesses involved in the tests both methods agreed satisfactorily with the experimental data. (TTT)

14206 INVESTIGATIONS ON SHIELDING CONCRETE. Juergen Seetzen (Deutsche Elektronen-Synchrotron, Hamburg). VDI Zeitschrift, 104: 124-8(Jan. 21, 1962). (In German)

The dose rate expected on concrete shielding from ionizing radiation can be calculated by various theories of radiation attenuation and transport of particles. Thus, the influence of the composition of the concrete on the shield thickness required for a given dose rate, the most appropriate composition, and the thermal stresses due to radiation absorption can be estimated. (N.W.R.)

Theoretical Physics

14207 (ARL-236) LIOUVILLE-EQUATION IN RELATIVISTIC DYNAMICS. Technical Note No. 2. G. Kalman (Israel Inst. of Tech., Haifa). Sept. 30, 1961. Contract AF61(052)-393. 5p.

Although the Liouville equation is based on a Hamiltonian formalism and there is no Hamiltonian in relativistic dynamics, it is shown that the modified Hamiltonian description of Schmutzer leads to the Liouville equation again and that it can serve as a foundation for relativistic statistical mechanics. (auth)

14208 (JINR-P-843) O PERENORMIROVKE MODELEI TEORII POLYA S FIKSIROVANNYM NUKLONOM. (On the Renormalization of Field Theory Models with Fixed Source). G. V. Efimov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 12p.

The renormalization of a class of models of quantum field theory with a fixed source in perturbation theory is carried out, ignoring the Feynman graphs. The renormalization procedure is of an algorithmic nature. (tr-auth)

14209 POISSON BRACKETS IN THE CASE OF A FIELD WITH LINEAR LAGRANGIAN. Philippe Droz-Vincent. Compt. rend., 253: 2862-4(Dec. 18, 1961). (In French)

In the framework of a hypersurface of the space mode, a definition of the Poisson bracket is given, based on the theory of infinitesimal transformations. It is applied to the gravitational field. (tr-auth)

14210 A NEW GAUGE INVARIANCE. Kuo-Hsien Tzou. Compt. rend., 253: 2868-70(Dec. 18, 1961). (In French)

A new gauge invariance of the mass doublet fields is studied. The study necessitates the introduction of a new C_λ field. The existence of this field engenders a new selection rule (additive rule) which forbids all nonneutrino μ-e transitions. (tr-auth)

14211 A SELF-CONSISTENT FIELD THEORY OF QUANTUM ELECTRODYNAMICS. M. Scahs (McGill Univ.,

Montreal) and S. L. Schwebel. Nuovo cimento (10), 21: Suppl. No. 2, 197-229(1961). (In English)

A theoretical approach based on the postulate that the laws of nature must be described in terms of field variables associated only with elementary interactions is presented in the development of a self-consistent field theory of quantum electrodynamics. Maxwell's equations are presented in spinor form. A self-consistent field theory is discussed in terms of the principle of least action, field equations, and the continuity condition. The Pauli exclusion principle is considered. Positronium and pair annihilation-creation process are presented in terms of field equation solutions and the energy and momentum of positronium in the annihilation state. The Lamb shift and the field equation linearizations of the hydrogen spectrum are discussed. (L.N.N.)

14212 THEORY OF LONG-RANGE INTERATOMIC FORCES. III. FIRST-ORDER INTERACTION ENERGIES IN THE COUPLED REPRESENTATION. Peter R. Fontana (Yale Univ., New Haven). Phys. Rev., 125: 1597-1602 (Mar. 1, 1962).

The effect of spin-orbit coupling on the long-range interatomic forces is computed. The representation is diagonal in the spin-orbit Hamiltonian of the two interacting atoms, and the electrostatic perturbation quantizes the total angular momentum J along the internuclear axis. The theory is applied to the interaction of two atoms in the one-electron approximation. In particular, resonance interactions of normal and excited atoms, and the interaction energies between atoms in excited states are calculated. The use of a coupled representation is valid only as long as the electrostatic interaction is a true perturbation on the system. To investigate the transition from a representation in which spin effects are neglected to the one that includes the spin-orbit coupling correctly, a more general perturbation method is formulated. (auth)

14213 RENORMALIZATION OF QUANTUM ELECTRODYNAMICS IN A CLASSICAL GRAVITATIONAL FIELD. Ryoyu Utiyama (Univ. of North Carolina, Chapel Hill). Phys. Rev., 125: 1727-40(Mar. 1, 1962).

The divergences of the Green's functions of electrons and photons in a classical gravitational field are investigated and are found to be removable by the introduction of suitable counter terms into the Lagrangian. These counter terms are obtained by rewriting the conventional renormalization technique in a generally covariant way. It is shown that infinite renormalization constants identical to those appearing in conventional quantum electrodynamics are also sufficient for the removal of all divergences when a gravitational field is present. No other renormalization is necessary. The segregation of the divergences is accomplished by making use of the transformation properties of the Green's functions under general coordinate transformations, Vierbein rotations, and gauge transformations. (auth)

14214 MASS QUANTIZATION AND LEPTON THEORY. Marcel Wellner (Indiana Univ., Bloomington). Phys. Rev., 125: 1750-4(Mar. 1, 1962).

Some features of mass quantization obtained by the introduction of a continuous inner degree of freedom into a free field are discussed. The usual particle interpretation, with discrete mass values, is applicable, as shown in the case of a second-quantized scalar field. A simple class of fermion field equations with unexpected lepton-like properties is also presented and studied in some detail. (auth)

14215 QUANTUM STATISTICAL DIAGRAM REPRESENTATION IN THE PRESENCE OF BOSE-EINSTEIN DEGENERACY. S. Fujita (Université Libre, Brussels). Physica, 27: 1161-9(Dec. 1961). (In English)

A contraction theorem for a product of boson operators averaged over the modified grand canonical ensemble of free particles is established. The theorem enables use of the quantum statistical diagram technique for calculation of statistical mechanical quantities of the degenerate interacting bosons. The diagram technique is illustrated by calculating the grand partition function of hard-sphere bosons above and below the temperature of the Bose-Einstein condensation. (auth)

14216 THE DIRECTION OF TIME. O. Penrose (Imperial Coll. of Science and Tech., London) and I. C. Percival. Proc. Phys. Soc. (London), 79: 605-16(Mar. 1, 1962).

A law is postulated which describes the asymmetry of probability distributions under time reversal. Briefly, it states that influences coming from infinity in different directions are statistically independent; a precise statement of the law is provided. This irreversible statistical law supplements the reversible dynamical laws of classical relativistic fields and particles, and from it the time direction of irreversible physical processes can be derived. This is illustrated by deriving the time direction of (i) electromagnetic waves radiated from a dipole, (ii) the scattering of beams of particles, and (iii) recording processes. A restricted law of increasing entropy is also obtained, and some cosmological implications of the theory are indicated. No attempt is made to derive detailed kinetic equations for the irreversible processes in many-particle systems. To ensure that all temporal asymmetries in the theory derive from the postulated law, a symmetric definition of probability is provided. (auth)

14217 CONSTRUCTION OF SOME ELECTROSTATIC FIELDS IN GENERAL RELATIVITY. S. Datta Majumdar (Univ. Coll. of Science, Calcutta). Proc. Phys. Soc. (London), 79: 657-8(Mar. 1, 1962).

In a previous paper (Majumdar, Phys. Rev. 72: 390(1947)) the functional relation $g_{44} = e^{\omega} = 1 + 2B\phi + \phi^2$ was shown to be the only one possible between the electrostatic potential ϕ (in e.s.u.) and the component g_{44} of the metric tensor, and the most general solution of the field equations for the special case $B = \pm 1$ was obtained. In the present note the following theorem is proved: Given a pure gravitational field in empty space an infinite number of electrostatic fields of the above type can always be constructed. (L.T.W.)

14218 PHYSICS IN THE SOVIET UNION. An Exposition of Theoretical Physics. A. S. Kompaneets (Kompaneyets). Translated from the Russian. New York, Philosophical Library, 1962. 590p. $7.50.

A review is presented of classical nonrelativistic and relativistic electrodynamics, along with derivations of pertinent aspects of relativity theory. A summary is also given of microscopic quantum mechanics, including such aspects as radiation, dispersion, and scattering theory. Microscopic analogs of thermodynamics (i.e., statistical physics) are reviewed, with particular attention devoted to Boltzmann and Gibbs statistics and Fermi and Bose distributions. A derivation of Lagrangian mechanics is also outlined. (T.F.H.)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 12831, 12833, 12844, 13137, 14042, and 14061.

14219 (ANL-6478) DYNAMIC ANALYSIS OF THE OPERATION OF EBWR AT 100 MW. N. Suda and F. Rehbach (Argonne National Lab., Ill.). Dec. 1961. Contract W-31-109-eng-38. 65p.

Two modes of operation of EBWR based on combustion control and pressure control of the steam generator were compared from the viewpoint of plant control. The transfer functions of each component of the plant were derived by theoretical analysis and then simulated with an analog computer. Then disturbances were applied to the system and the transient responses were recorded. The optimum settings of the controllers were determined. The specific features and limitations of each of the two modes are discussed. (M.C.G.)

14220 CISE-91) THERMO-HYDRAULIC PRELIMINARY STUDY OF A FIXED BED FUEL ELEMENT. G. Palladino and G. Perona (Centro Informazioni Studi Experienze, Milan). Dec. 1961. 25p.

Results of a preliminary study concerning fixed bed fuel elements which produce superheated steam are presented. The study is limited to aspects of fluid flow and heat transfer in steady state conditions. (J.R.D.)

14221 (CRE-1062) DEVELOPMENT OF A RELIABLE MAGNET ASSEMBLY FOR THE NRU CONTROL ROD. R. D. Watson (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Aug. 1961. 25p. (AECL-1413)

An all-welded stainless steel magnet assembly containing polyurethane impregnated Fiberglas wire was developed for service in the NRU control rods. The magnet assembly is expected to provide the necessary reliability, since the joints originally made by soldering have either been eliminated or replaced with welded joints. After the magnet assembly has proven itself in service in NRU, it will be used to replace the original chrome-plated Armco iron magnets and conduit coils. (auth)

14222 (DC-58-1-72) SHIM CONTROL SYSTEM AND SAFETY ACTUATOR CONTROL SYSTEM FOR PROJECT 102 (D-102-A) REACTOR. Harry E. Bell (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 9, 1958. Contract AT(11-1)-171. 41p.

The components used in the shim and safety circuits of HTRE #3 are listed. A general discussion of each component is included with the basic operating features of the system. Further operating and maintenance information can be found in DC 57-12-148. (auth)

14223 (DC 58-1-83) CORE HEATING EFFECTS DUE TO GAMMA LIBERATED SECONDARY ELECTRONS. M. R. Smith (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 6, 1958. Contract AT(11-1)-171. 17p.

The design of small ionization chambers used to determine the core heating effects from gamma liberated secondary electrons is described. The suggested ionization chambers are of such configuration as to be used in the TSM reactor and specifications are given for chambers to be constructed of several different moderator materials. (auth)

14224 (DC 58-5-51) MODERATOR TRANSIENT TEMPERATURE STUDY. J. M. Brunso (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 29, 1958. Contract AT(11-1)-171. 40p.

An IBM 704 computer program is presented to perform a moderator transient temperature study for determination of the fuel element and moderator temperatures as a function of time upon sudden or accelerated reactor power levels. (auth)

14225 (DC 59-8-127) COMPILATION OF UNCLASSIFIED PROJECT 102 CONTROLS AND INSTRUMENTATION SCHEMATIC DIAGRAMS, DRAWINGS AND PHOTOGRAPHS. J. A. Showlater (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 14, 1959. Contract AT(11-1)-171. 136p.

A compilation is presented of drawings, photographs, sketches, and curves relevant to the D102-A system. It covers the reactor, engine, and auxiliary control systems with most emphasis being placed on the reactor control system. These drawings and photographs are assembled for reference and instruction purposes. (auth)

14226 (DC-58-8-231) OPERATION AND PERFORMANCE OF TEMPERATURE-CONTROL CIRCUIT PROJECT 102, CONTROL SYSTEM. James E. Mott (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 27, 1958. Contract AT(11-1)-171. 71p.

A report on the theory of operation, design, calibration and test, and the performance of a temperature-control circuit for project 102 is presented. The various components are discussed and typical circuit data are presented along with schematic drawings, sketches, and photographs. Tests of transient response and steady-state accuracy of the temperature-control circuit, operated in connection with both the control system mockup and the final manufactured system, gave satisfactory results. (auth)

14227 (DC-58-9-35) TEST OF P-102 PRIMARY SHIELD BOLTS. Report No. 419. R. Roberts (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 3, 1958. Contract AT(11-1)-171. 40p.

Torque tests were conducted on each type of bolt used in the P-102 primary shield components to obtain test data for use in the shield assembly. The torque value ranges needed to obtain the design preload for each bolt were determined. Actual assembly conditions were duplicated as to materials, nuts, and washers. A comparison was also made of thread lubrication methods including Molykoting with no excess remaining, dipping Molykote with the excess remaining on the bolt, and no lubrication at all. The type of bolts and test conditions were constant. The method of Molykote application has a very distinct effect on the torque versus tension characteristics of a bolt. (auth)

14228 (DC 58-12-124) MEASUREMENT OF THE SPECIFIC HEATS OF TWO MODERATOR MATERIALS. J. J. Baum and S. N. Stilwell (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 10, 1958. Contract AT(11-1)-171. 25p.

The specific heats of two reactor moderator materials were measured with an accuracy of $\pm 1\%$ at 35 to 90°C using an adiabatic vacuum calorimeter. Curves showing the specific heat versus temperature of both solid materials are shown and some general aspects of calorimetry methods are discussed. (auth)

14229 (DC-59-8-130) XENON BUILDUP AND DECAY FOR A HOMOGENEOUS REACTOR REGION. C. S. Robertson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 30, 1959. Contract AT(11-1)-171. 22p.

ANP 704 digital computer program No. 358 is documented. Calculations done by use of the program and the input and output information necessary for its operation are described. The program is used to compute the concentration of Xe^{135} and I^{135} in a homogeneous reactor region as a function of time and neutron flux (power level). (auth)

14230 (FD-74) MARK XIV-19-ELEMENT NRU ROD. J. S. Nelles (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1961. 16p.

For presentation at the Fourteenth Joint U.S.-Canadian Sheath Program Meeting, Savannah River Plant, Nov. 7 and 8, 1961.

The 19-element rod for NRU is an alternative design to the present flat rod type. Experimental cores were fabricated by hot rolling and extrusion in the gamma phase. The cores are extrusion clad with Al to a thickness of 0.025 in. Spiral fins are extruded integral with the cladding for locating the element and helping to promote mixing of the coolant. Spacers are located in the flow tube to position the elements. Development work on the rod assembly is still in progress. (auth)

14231 (FXM-1071) REACTOR POISONING. B. Bellow and R. Chapman (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Mar. 2, 1955. 20p. Contract [AT(11-1)-229].

An investigation was made of the poisoning effect of the fission products of U^{235} in the fireball reactor. The problem was divided into two parts: to find the poison concentration in the reactor fuel after a length of time and to find the change in the average number of neutrons produced per fission for various concentrations of the poison. The reactivity due to each of the isotopes was calculated and the sum of these reactivities was found. The total reactivity was plotted at 1000 hours on a graph of reactivity versus operation time. (M.C.G.)

14232 (GEMP-71) REACTOR INSTRUMENTATION AND CONTROL PROGRESS REPORT NO. 71, DECEMBER 1, 1961-MARCH 1, 1962. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Mar. 21, 1962. Contract AT(40-1)-2847. 43p.

Progress on reactor instrumentation and control programs is reported. Circulating ball reactivity control, static switching, capacitance temperature sensor, high-temperature extension of conventional nuclear sensors, development of nuclear sensors, high-temperature fasteners, and fasteners for remote maintenance are discussed. (M.C.G.)

14233 (KR-16) QUARTERLY PROGRESS REPORT [ON KJELLER RESEARCH] OCTOBER-NOVEMBER-DECEMBER, 1961. (Norway. Institutt for Atomenergi, Kjeller). Feb. 1962. 47p.

Installation of an enriched fuel element in the JEEP reactor to increase radioisotope output capability is reported. Control stations for the Halden reactor were completed and NORA reactor was inaugurated. A method was developed for turning the polarization vector of polarized neutrons in the magnetized mirror experiment. Other work is reported on UO_2 sintering corrosion experiments, fabrication of fuel test specimens, reprocessing plant flow sheet testing, and waste disposal. (J.R.D.)

14234 (NAA-SR-Memo-6781) FUEL ELEMENT PHYSICS EVALUATION TECHNIQUES IN USE AT OTHER LABORATORIES. F. J. Jankowski (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 11, 1961. Contract [AT(11-1)-Gen-8]. 12p.

The experimental and theoretical methods utilized by other laboratories to obtain reactor physics information from a limited quantity of fuel elements were reviewed. It is shown that at least six elements are usually required for meaningful measurements. However 12 elements is a number frequently used. (auth)

14235 (NEI-13(Rev.)) A MICROSCOPIC-DISCRETE THEORY OF THERMAL-NEUTRON PILES. J. D. Stewart (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1962. 27p. (AECL-1470)

The microscopic-discrete theory takes into account the reactor lattice structure by representing each rod by a line source of fast neutrons and a line sink of thermal neutrons. The application of the method to the problem of determining the Laplacian of a new lattice by substituting some rods of it for rods of a lattice of known Laplacian is considered. (D.L.C.)

14236 (NUMEC-P-39) DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS. Monthly Progress Letter for Month of February 1962. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Mar. 5, 1962. Contract AT(30-1)-2389. 4p.

Major effort during the report period was directed toward the in-pile testing program. Component PuO_2 and UO_2 powder blending trials were continued along with coprecipitated powder characterization studies. Arrangements for irradiation of short exposure rabbit capsules were made. (J.R.D.)

14237 (ORNL-TM-172) PRELIMINARY DESIGN OF THE HFIR CORE AND PRESSURE VESSEL ASSEMBLY. J. R. McWherter (Oak Ridge National Lab., Tenn.). Mar. 21, 1962. Contract [W-7405-Eng-26]. 36p.

Formerly issued as CF-61-8-75.

A general description of the High Flux Isotope Reactor core and pressure vessel assembly is given. Criteria and proposed designs for the target assembly, fuel element, control equipment, reflector, experimental facilities, and pressure vessel are given. The operating conditions and other design data are presented in tabular form. (auth)

14238 (RFR-39) THE COLLISION PROBABILITY OF CYLINDRICAL TUBES. Progress Report. I. Carlvik (Aktiebolaget Atomenergi, Stockholm). Oct. 9, 1959. 16p.

The collision probability in a cylindrical tube is studied. Calculations are performed for an outer radius of the tube of from 0.1 to 6.0 mean free paths, and for the inner radius/outer radius ratio from 0.4 to 0.95. The collision probability is given for an empty tube, and for a tube filled with a source-free material having the same macroscopic cross section as the tube material. The probabilities for collision in the tube material and in the inner material are given separately in the latter case. (auth)

14239 (RISÖ-34) SAFETY AND RELIABILITY OF REACTOR INSTRUMENTATION WITH REDUNDANT INSTRUMENT CHANNELS. Jens Rasmussen and P. Timmermann (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). Jan. 1962. 41p.

The safety and reliability of reactor instruments and redundant systems are described by the rate of reactor shutdowns caused by safe failures of instruments, and by the length of time during which unsafe failures of instruments exist. The effect of repair and test during operation is considered. The safety parameters are determined for redundant "n-out-of-m" systems. (auth)

14240 (TID-15194) TEMPERATURE ANALYSIS OF HOLLOW CYLINDRICAL FUEL ELEMENTS. A Bibliography. Helen S. Stearns, comp. (Los Alamos Scientific Lab., N. Mex.). Mar. 11, 1960. Contract [W-7405-Eng-36]. 8p. (D-BIB-33)

A bibliography on the temperature analysis of hollow cylindrical fuel elements is presented. The 55 references are arranged according to author. (M.C.G.)

14241 (TIM-482) FINAL REPORT OF THE IN-PILE THERMAL CONVECTION LOOP PROJECT. A. J. Parks (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Feb. 21, 1958. Contract [AT(11-1)-229]. 21p.

A summary is presented of development, irradiation work, and post-irradiation examination of the Pratt and Whitney in-pile thermal convection loops containing molten modified ORNL composition 30 fuel. It was found that the compatibility of the fluoride fuel with Inconel and Inconel X was reasonably satisfactory at 1200°F, and the stability of the fluoride fuel in the loop was also satisfactory. It is noted that prediction of thermal neutron fluxes and maintenance of fixed-level power in the MTR was not feasible under the experimental conditions. (J.R.D.)

14242 (FTD-TT-61-124) STUDY OF CRITICAL PARAMETERS FOR REACTOR SYSTEMS (COLLECTION OF ARTICLES). Translated from p.3-117 of "Issledovaniya Kriticheskikh Parametrov Reaktornykh Sistemy" Sbornik Statei (A publication of the State Publishing House of Literature in the Field of Nuclear Science and Tech., Moscow, 1960). 182p.

A total of 9 papers is included, 5 of which separate abstracts were prepared. The remaining 4 papers which were previously abstracted in NSA included information on critical masses in Be, graphite, and spherical reactors, and critical masses of water mixtures of U and Pu compounds. (J.R.D.)

14243 (FTD-TT-61-124(p.2-35)) EXACT SOLUTIONS OF SINGLE VELOCITY KINETIC EQUATION AND THEIR APPLICATION IN CALCULATING DIFFUSION PROBLEMS (IMPROVED DIFFUSION METHOD). Yu. A. Romanov. Translated from "Issledovaniya Kriticheskikh Parametrov Reaktornykh Sistemy."

The information is presented in sections on solution of Milne's problem and determination of albedo of semi-infinite media, and solution of kinetic equations for two oscillating semi-infinite media and for a sphere. Information is also included on the use of exact solutions to calculate diffusion problems, critical dimensions of a plate and sphere, and multiplication factor for point sources in homogeneous spheres. (J.R.D.)

14244 (FTD-TT-61-124(p.49-57)) USE OF EVEN APPROXIMATIONS IN SPHERICAL HARMONIC METHOD. G. Ya. Rumyantsev. Translated from "Issledovaniya Kriticheskikh Parametrov Reaktornykh Sistemy."

It is noted that in solving the Boltzmann equation by the spherical harmonic method, the P_N approximations are used in which N is the order of approximation. It is shown that in cases in which the use of approximations of a low order is generally possible, the P_2 approximation can make the P_1 considerably more accurate, while the laborious nature of P_2 increases only slightly. (J.R.D.)

14245 (FTD-TT-61-124(p.105-55)) INTERACTION OF SYSTEMS OF FISSILE MATTER IN A SCATTERING MEDIUM. V. G. Zagrafov. Translated from "Issledovaniya Kriticheskikh Parametrov Reaktornykh Sistemy."

The interaction of systems of fissile matter is analyzed by finding the critical parameters j^0 and j^{00} using the asymptotic diffusion method and by use of a kinetic equation for averaged neutron density. Both methods are considered applicable irrespective of the relative dimensions of the bodies, distances between them, and free paths of the neutrons in the media. Limitations are discussed. (J.R.D.)

14246 (FTD-TT-61-124(p.156-63)) EXPERIMENTAL STUDY OF INTERACTION BETWEEN TWO SUBCRITICAL REACTORS. A. V. Kamaev (Kamayev), B. G. Dubovskii, V. V. Vevilov, G. A. Popov, Yu. D. Palamarchuk, and S. P. Ivanov. Translated from "Issledovaniya Kriticheskikh Parametrov Reaktornykh Sistemy."

Experiments are described which were conducted to determine the critical state of a system consisting of two cylindrical homogeneous reactors without reflectors in an ordinary air medium with various distances between them. Results are included. (J.R.D.)

14247 (FTD-TT-61-124(p.164-81)) CALCULATION OF SECTIONALIZED NUCLEAR POWER PLANTS. G. I. Marchuk, B. G. Bubovskii (Bubovskiy), V. V. Smelov, and Z. N. Milyutina. Translated from "Issledovaniya Kriticheskikh Parametrov Reaktornykh Sistemy."

Mathematical calculations made in connection with a study of sectionalized reactor systems for nuclear energy in subcritical reactors are presented. The physical system is to some extent a further development and generalization of the physical in the PWR. It is shown that in sectionalized reactor systems production of high fluxes of thermal neutrons is possible. (J.R.D.)

14248 THE PORTABLE γ RAY EQUIPMENT GUPOS-Cs^{137}-800 FOR IRRADIATING SEEDS BEFORE SOWING. A. V. Bibergal', K. N. Emel'yanov, M. M. Korotkov, N. I. Leshchinskiĭ, and T. G. Ratner. Atomnaya Energ., 12: 159-60(Feb. 1962). (In Russian)

Previous experiments which indicated that irradiation of seeds prior to sowing stimulates the growth and the maturing of plants were carried out on a relatively small scale and did not involve a study of the commerical applicability of the method. For this reason, the first portable γ-ray source of the Soviet Union was designed and built at the Institute of Biological Physics of the USSR Academy of Sciences, making it possible to expose about 1 ton of seeds to a daily dose of about 1 r. The device consists of a lead-coated cast-iron body mounted on a movable platform; a rod holding 2 exposure chambers shielded with 3 Pb plugs and 8 tightly encapsulated Cs sources are placed within the body. The low energy Cs^{137} radiation requires only one-third of the shielding needed for a Co^{60} source of equal strength. The relatively low weight of 1 ton of the unit makes it possible to transport it on a trailer. The dose rate at the surface is less than 3.0 mr/hr and at 1 m less than 0.3 mr/hr, thus being within the permissible level for Group 2 materials of the Soviet transportation code for radioactive materials. The device will be used for agricultural studies in various climatic zones. (TTT)

14249 THE SCHROEDINGER EQUATION APPLIED TO THE CALCULATION OF FLUCTUATIONS OF NUCLEAR REACTORS. Augustin Blaquière and Roza Pachowska. Compt. rend., 253: 2938-40(Dec. 18, 1961). (In French)

The formal analogy between the Fokker-Planck equation of nuclear reactors, obtained from the generating function of probabilities, and the Schroedinger equation utilized to describe the evolution of quantum systems has led to an attempt to define the relationship of the two theories. It was shown that the second method is also applicable to the

study of reactor fluctuations. In this case, the Schroedinger equation appears as the matrix transcription of the Fokker-Planck reactor equation. (tr-auth)

14250 ON THE CALCULATION OF THE THERMAL UTILIZATION OF NEUTRONS IN A PLATE LATTICE. J. Lacina (Computing Lab. of Transport and Communications Prague). Czechoslov. J. Phys., B 12: 80-1(1962). (In English)

A method of calculation assuming the thermal source is zero in the fuel and constant in the moderator is proposed. It is shown that confinement to the first approximation by a diffusion approximation is sufficient. In the moderator that forms most of the medium, the diffusion approximation agrees with the neutron flux. Convergency can be proved rigorously. (L.N.N.)

14251 EFFECT OF AN EXTERNAL NEUTRON SOURCE ON A SUBCRITICAL, CRITICAL AND SUPERCRITICAL REACTOR. E. Pedretti and G. Szabó Miszenti (SORIN, Centro Ricerche Nucleari, Saluggia, [Italy]). Energia nucleare (Milan), 9: 65-72(Feb. 1962). (In English)

An elementary theory is used to describe the time behavior of a subcritical, critical, and supercritical reactor when an external source is put near it. Neutron absorption by the source is considered. Experiments performed at the Sorin swimming-pool reactor confirm the theoretical predictions. Criteria for better positioning and removing of the start-up source are deduced from the time behavior of a supercritical reactor. (auth)

14252 OSCILLATOR BIAS AND FREQUENCY RESPONSE IN NONLINEAR ZERO POWER KINETICS. C. N. Shen (Rensselaer Polytechnic Inst., Troy, N. Y.). J. Franklin Inst., 273: 201-10(Mar. 1962).

Assuming the classical zero power space independent kinetic equations are valid, the fractional change in neutron population is given by: $(\delta n/n_0) = G(p)(k_{ex} + k_n)$. The expression G(p) represents the reactor transfer function in real time, and the equivalent reactivity is composed of an input reactivity k_{ex} and a nonlinear product k_n, which is jointly dependent upon the input reactivity and the fractional change in the neutron density. A reactivity bias was calculated which to a good approximation will result in a harmonic output. Assuming the sensitivity ($\delta k/\Delta n$.) of the oscillator to be linear, the stroke offset can be specified as a function of the oscillator frequency, length of stroke, sensitivity, and the effective $1/\beta$. (auth)

14253 THE 'HUBBLE-BUBBLE' CONTROL SYSTEM. D. L. Booth (English Electric Co. Ltd.). Nuclear Power, 7: No. 71, 51-3(Mar. 1962).

Pressure tube reactors can be controlled by changing the moderator level, which is a simpler process than using a large number of control rods. The main disadvantage is that no mechanism is provided for overcoming local reactivity changes. Thus, a method is described for controlling local reactivity changes by passing a stream of bubbles through the moderator. Hence, neutron flux distribution can be controlled, xenon override provided, and a more rapid rate of emergency shut-down obtained. (N.W.R.)

14254 A VARIATIONAL PRINCIPLE FOR NONLINEAR SYSTEMS. Jeffery Lewins (Staff Coll., Camberley, Surrey, Eng.). Nuclear Sci. and Eng., 12: 10-14(Jan. 1962).

The equations describing a reactor system are sometimes nonlinear and do not admit a solution for the neutron density that is separable into a function of time only and a function of the remaining variables. An appropriate variational principle is given by demanding that the calculation of the observable nature of the reactor is insensitive to the value employed for the density, thus obtaining an equation for the optimum distribution of detectors to measure the observable behavior. This optimum weighting function is not identical with the conventional adjoint function or importance in the nonlinear range but the conventional treatment of linear systems is found to be a special case of the general principle. It is shown that the approximate treatment of nonlinear systems as eigenvalue systems is fundamentally unsound. (auth)

14255 LABORATORY EXPERIMENTS USING A PULSED NEUTRON SOURCE. Russell B. Mesler, Harry G. O'Brien, and DeBow Freed (Univ. of Kansas, Lawrence). Nuclear Sci. and Eng., 12: 79-81(Jan. 1962).

Laboratory experiments using pulsed neutron techniques are valuable for giving physical interpretation of reactor theory. Three experiments illustrate different pulsed neutron measurements. In one case diffusion properties of a sample are measured by varying the geometry of the sample. In another the absorption cross section of a solute is measured by varying the sample without changing its geometry. A third experiment illustrates the use of a pulsed neutron source in reactivity measurements. (auth)

14256 AN ELECTRICAL ANALOGY OF NUCLEAR REACTOR NEUTRON FLUX. J. R. Eaton and R. L. Long (Purdue Univ., Lafayette, Ind.). Nuclear Sci. and Eng., 12: 82-90(Jan. 1962).

A technique is described for simulating the neutron diffusion equations by an electrical analogy of a transmission line. The analog may be constructed for single or multi-energy groups in one, two, or three dimensions. Examples are presented of one-dimensional systems studied by one-group and by two-group theory. The technique is considered to be especially useful for the instruction of students because it enables them to obtain an insight into the characteristics of the solution and to gain an appreciation of the factors which affect the results. (auth)

14257 EPOXY COATING GUARDS POWERFUL NUCLEAR REACTOR. Charles E. Pimbley (Patterson Sargent Co.). Research/Develop., 13: No. 4, 54; 56-8 (Apr. 1962).

A protective epoxy coating, resistant to high gamma radiation for long periods, was applied to the concrete and steel surfaces at the NASA Research Reactor. The epoxy resin coating material was selected primarily for strength of adhesion to both concrete and steel, effectiveness as a water barrier, high mil buildup for low-cost application, and resistance to high gamma radiation. The formulation was an amine-cured system based on Epon resin. (M.C.G.)

14258 WAYS AND MEANS OF RELIEVING PRESSURE ON REACTOR BUILDINGS IN THE EVENT OF AN ACCIDENT. Rainer Rothe (Siemens-Schuckertwerke A.G., Erlangen, Ger.). Tech. Überwach., 2: 377-81(Oct. 1961). (In German)

Steel safety casings for pressure-water and boiling-water reactor structures can be designed for low pressures if steps are taken to prevent pressure building up excessively. These steps consist in using water to condense the steam formed when damage occurs to the reactor. The advantages offered by this method are that construction work is kept to a minimum, the fission products are retained in the water, and damage to the reactor is prevented in the event of an accident. (auth)

14259 EXPERIENCES FROM CONSTRUCTION, MANUFACTURE AND ERECTION OF A NUCLEAR REACTOR. Wilhelm Liebig (Dinglewerke A. G., Zweibrücken, Ger.). VDI Zeitschrift, 104: 120-3(Jan. 21, 1962). (In German)

The problems encountered in the construction of a reactor are discussed with respect to close tolerances and constant checking of work. Some problems encountered during erection have to be clarified by means of model tests. The construction of biological shielding calls for unusual accuracy in concrete and steel erection and may be achieved only by constant and painstaking supervision. (N.W.R.)

14260 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Robert Eyre and George Camac (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 891,799. Mar. 21, 1962.

An emergency shut-down device of the type described in British Patent 882,361, in which neutron-absorbent pellets are allowed to fall into a duct in the core, is designed with means for resetting the equipment after a trip. The means comprises a plunger at the bottom of the duct and which may be raised to lift the pellets to the inoperative position. (D.L.C.)

14261 IMPROVEMENTS IN OR RELATING TO MODERATOR CORE STRUCTURES FOR NUCLEAR REACTORS. Harry Albert Cox (to General Electric Co., Ltd.). British Patent 891,865. Mar. 21, 1962.

A moderator core structure composed of graphite blocks is designed with means for stabilizing the core against Wigner changes. The structure includes keyed locating tile members and I-shaped key members adapted so that dimension changes produce rotary movement of the tile members to maintain the relative location of the lines of the blocks. (D.L.C.)

14262 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Stanley Hackney (to United Kingdom Atomic Energy Authority). British Patent 892,240. Mar. 21, 1962.

A reactor fuel element assembly is designed with an easily manipulated coupling between adjacent elements. The coupling comprises on one end of a fuel element a circular member with a series of projections and cavities and on the other end a ring member with similar projections and cavities. By passage of the projections of the circular member through the cavities of the ring member and subsequent rotation, the circular and ring members are coupled together with a small clearance between projections. (D.L.C.)

14263 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS OF NUCLEAR REACTORS. Norman Bradley (to United Kingdom Atomic Energy Authority). British Patent 892,241. Mar. 21, 1962.

A reactor fuel element of the cluster type is designed with end terminations for interconnection at its ends with the ends of adjacent fuel elements. The end terminations comprise at least two lugs at one end and claw members of hook-like form at the other end for engaging the lugs of an adjacent element. (D.L.C.)

14264 SAFETY ARRANGEMENT FOR A NUCLEAR REACTOR ABOARD A SHIP. (to Foster Wheeler Ltd.). British Patent 892,290. Mar. 21, 1962.

A safety arrangement is described for preventing an explosion of the reactor or release of radioactive materials to the atmosphere due to overheating of the reactor when it is shut down. The arrangement, designed for ship reactors using fluid fuel, comprises a fluid-tight compartment containing the reactor and located within a shield, the space between the shield and the compartment wall defining a jacket which is filled with water from outside the ship if the reactor cooling system fails. Circulation of the water by convection is provided. (D.L.C.)

14265 FUEL ELEMENTS FOR NUCLEAR FISSION REACTORS. (to Deutsche Gold- und Silber-Scheideanstalt Vormals Roessler). British Patent 892,341. Mar. 28, 1962.

A reactor fuel element is described which has a good thermal conductivity, high fuel density, dimensional stability with respect to temperature and radiation effects, and good corrosion resistance to water. The fuel element comprises a shaped piece of UC, PuC, ThC, or a mixture thereof, a protective can, and a thin protective layer between the can and the shaped piece. The protective layer may be a U silicide, a carbide or silicide of one of the elements of the Periodic System Groups IV to VI except Hf and Ta, a metal, or successive layers thereof. (D.L.C.)

14266 A METHOD OF PREPARING FUEL ELEMENTS FOR NUCLEAR REACTORS. (to U. S. Atomic Energy Commission). British Patent 892,559. Mar. 28, 1962.

A method is outlined for preparing fuel elements of U or U-base alloy core clad in Zr or a Zr-base alloy which are relatively resistant to corrosion by water even if the cladding is defective. This resistance in the presence of defects is brought about by heat treatment of the fuel elements at temperatures >800°C, the length of the heat treatment ranging from ~24 hr at 850°C to 1 hr at 1100°C. Data are presented on the effects of such heat treatment on the corrosion resistance of U–2 wt % Zr bars sealed in Zircaloy-2 and extruded; the corrosive environments were water at 600°F and steam at 750°F, 1500 psi. (D.L.C.)

14267 NUCLEAR REACTOR FUEL ELEMENT WITH IMPROVED HEAT TRANSFER CHARACTERISTICS. J. E. Mahlmeister (to U. S. Atomic Energy Commission). U. S. Patent 3,028,329. Apr. 3, 1962.

A reactor fuel element with improved heat transfer characteristics, capable of operating at higher average power density and temperature, is described. The element comprises a tubular metal container, which could be stainless steel, and a plurality of aligned fuel segments, such as uranium dioxide, positioned in the container. The exterior of the fuel segments and the container define an annular space. Axial channels in each successive segment are in axial alignment. Spacer means between the segments provide radial channels which connect the axial channels with the annulus and a plurality of axial grooves on the exterior of each segment. A molten metal, such as lead, circulates between the annulus and the axial channels. With this arrangement, 15 to 20 kw/ft power output is obtained, as compared to 7 to 8 kw/ft with a conventional solid UO_2 slug. (AEC)

14268 BOILING REACTORS. S. Untermyer (to U. S. Atomic Energy Commission). U. S. Patent 3,029,197. Apr. 10, 1962.

A boiling reactor having a reactivity which is reduced by an increase in the volume of vaporized coolant therein is described. In this system unvaporized liquid coolant is extracted from the reactor, heat is extracted therefrom, and it is returned to the reactor as sub-cooled liquid coolant. This reduces a portion of the coolant which includes vaporized coolant within the core assembly thereby enhancing the power output of the assembly and rendering the reactor substantially self-regulating. (AEC)

14269 NUCLEAR REACTOR FUEL ELEMENT. William F. Anderson, Douglas R. Tellefson, and Thomas T. Shimazaki (to U. S. Atomic Energy Commission). U. S. Patent 3,029,198. Apr. 10, 1962.

A plate type fuel element which is particularly useful for organic cooled reactors is described. Generally, the fuel element comprises a plurality of fissionable fuel bearing

plates held in spaced relationship by a frame in which the plates are slidably mounted in grooves. Clearance is provided in the grooves to allow the plates to expand laterally. The plates may be rigidly interconnected but are floatingly supported at their ends within the frame to allow for longitudinal expansion. Thus, this fuel element is able to withstand large temperature differentials without great structural stresses. (AEC)

14270 NEUTRONIC REACTOR CONTROL ELEMENT. R. J. Beaver and C. F. Leitten, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,030,294. Apr. 17, 1962.

A boron-10 containing reactor control element wherein the boron-10 is dispersed in a matrix material is described. The concentration of boron-10 in the matrix varies transversely across the element from a minimum at the surface to a maximum at the center of the element, prior to exposure to neutrons. (AEC)

14271 REACTOR CONTROL. Peter Fortescue and D. Nicoll (to U. S. Atomic Energy Commission). U. S. Patent 3,031,397. Apr. 24, 1962.

A control system employed with a high pressure gas cooled reactor in which a control rod is positioned for upward and downward movement into the neutron field from a position beneath the reactor is described. The control rod is positioned by a coupled piston cylinder releasably coupled to a power drive means and the pressurized coolant is directed against the lower side of the piston. The coolant pressure is offset by a higher fluid pressure applied to the upper surface of the piston and means are provided for releasing the higher pressure on the upper side of the piston so that the pressure of the coolant drives the piston upwardly, forcing the coupled control rod into the neutron field of the reactor. (AEC)

Power Reactors

Refer also to abstract 12832.

14272 (ACNP-6123) PATHFINDER ATOMIC POWER PLANT TECHNICAL PROGRESS REPORT, JULY 1961–SEPTEMBER 1961. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Feb. 15, 1962. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 105p.

Progress in the design of the Pathfinder Atomic Power Plant is reported. The topics covered include: fuel material cladding, bonding, and irradiation testing; heat transfer and fluid flow; fuel element manufacturing research and development; low-enrichment superheater fuel element; mechanical studies of control rods, guide tubes, and control rod drives; reactor physics (statistics); reactor and system dynamics; initial stability and performance test; and mechanical tests. (M.C.G.)

14273 (ANL-6512) A THEORETICAL STUDY OF DESTRUCTIVE NUCLEAR BURSTS IN FAST POWER REACTORS. V. Z. Jankus (Argonne National Lab., Ill.). Feb. 1962. Contract W-31-109-eng-38. 48p.

The calculation of destructive nuclear bursts in fast reactors by an improved Bethe-Tait method, which, for purposes of calculation, neglects propagation of the pressure wave is described. Then exact numerical calculations for hydrodynamic and neutronic conditions during the power burst are performed in order to assess the importance of this neglect. (auth)

14274 (APAE-53(Vol.II)) SM-2— TRANSIENT VOLTAGE AND FREQUENCY ANALYSIS BY PLANT ANALOG SIMULATION. Final Report. J. A. Barrett (Alco Products, Inc., Schenectady, N. Y.). Nov. 16, 1959. Contract DA-44-009-ENG-3506. 268p.

Four commercial speed control and turbine systems were investigated. A study was made of the performance of the 7500-kw electrical system for transient voltage regulation. A model of the proposed SM-2 vertical steam generator was derived for transient response studies. The thermal transient behavior of surface condensers and feedwater heaters was analyzed. (D.L.C.)

14275 (APAE-110) SM-1 REACTOR VESSEL CLOSURE STUD INVESTIGATION. D. L. Reali (Alco Products, Inc., Schenectady, N. Y.). Mar. 23, 1962. Contract AT(30-1)-2639. 42p.

Metallurgical analyses and corrosion tests conducted to determine causes of failure of two SM-1 reactor vessel studs due to fracture in the threaded areas, after 23 months' operation (March 1959) are described. It was concluded that failure of the studs was caused by stress corrosion cracking. Contributing factors to failure of the studs were improper control of heat treatment of the studs and absence of treatment for stress relief after thread grinding operation. (auth)

14276 (APAE-115(Vol.III)) PL-3, PHASE I, TASK 3, RESEARCH AND DEVELOPMENT REPORT. (Alco Products, Inc., Schenectady, N. Y.). Mar. 12, 1962. Contract AT(30-1)-2900. 150p.

Results of research and development tasks are presented along with recommendations for future development work. Work is reported in the areas of plant assembly and relocation, housings and footings, waste heat dissipation, instrumentation, refueling systems, waste disposal, shielding, core nuclear thermal and hydraulic studies, gaseous waste processing, and critical experiments on a 5 × 5 array of Type 3 fuel elements. (auth)

14277 (APAE-Memo-305) STARTUP AND INITIAL TESTING OF SM-1 CORE II WITH SPECIAL COMPONENTS. F. G. Moote and E. W. Schrader (Alco Products, Inc., Schenectady, N. Y.). Feb. 28, 1962. Contract AT(30-1)-2639. 45p.

The loading operation for SM-1 Core II is described. Results of startup physics measurements (Test A-300 Series) and fission product iodine monitoring in the primary coolant are given. The SM-1 Core II initial loading progressed satisfactorily, fulfilling the predictions of the zero power experiment performed at the Alco Criticality Facility. The initial cold clean five rod bank position was 6.53 in.; the initial hot, no xenon, five rod bank position was 9.62 in.; the initial hot, equilibrium xenon, five rod bank position was 11.41 in.; and the initial hot, peak xenon, five rod bank position was 12.14 in. Rods A and B were 19.00 in. in all four measurements. Stuck rod measurements indicated that an adequate shutdown margin was available with 20% of the rods fully withdrawn. All rod calibrations indicated a distinct shift and broadening of the peaks when compared with similar Core I calibrations. The temperature coefficient for Core II was 3.5 cents/°F at 440°F. Equilibrium xenon was worth approximately –$3.00 while peak xenon was worth –$4.43, both relative to the hot, no xenon core condition. During the period June 2, 1961 through September 30, 1961, the reactor operated at a total of 935.68°F days which is equivalent to 1.34 MWYR of energy release and represents an average load factor of 44% typical of training periods. The estimated reactivity in the core at startup is $10.00. A core life of 12.2 MWYR is predicted for the original configuration of Core II. The results of gross fission product iodine monitoring showed that those

levels were about one-third to one-half of those found at the end of Core I Operation. (auth)

14278 (APAE-Memo-308) EVALUATION OF HEAT REJECTION SYSTEMS FOR PL-3. C. J. Thurnau (Alco Products, Inc., Schenectady, N. Y.). Mar. 1, 1962. Contract AT(30-1)-2900. 29p.

An investigation was made of heat rejection systems for use in the PL-3 nuclear power plant, designed for placement at Byrd Station, Antarctica. It was concluded that the glycol-coupled surface condenser and air blast cooler combination appears to be suited for PL-3 plant requirements and operating conditions. (auth)

14279 (APEX-903) CORE TEST FACILITY. Comprehensive Technical Report, General Electric Direct-Air-Cycle, Aircraft Nuclear Propulsion Program. H. S. Daniel and J. I. Trussell—M. L. Halterman, ed. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Mar. 8, 1962. Contracts AF33(600)-38062 and AT(11-1)-171. 139p.

A summary description is presented of the Core Test Facility (CTF) that was used in the first two Heat Transfer Reactor Experiments (HTRE No. 1 and No. 2), which were conducted at the Idaho Test Station (ITS). The CTF consisted of shielding, an air supply, and other necessary auxiliaries and services, which were combined into assemblies in order to test a succession of direct-cycle cores, fuel elements, controls, and other components. (auth)

14280 (APEX-904) HEAT TRANSFER REACTOR EXPERIMENT NO. 1. Comprehensive Technical Report, General Electric Direct-Air-Cycle, Aircraft Nuclear Propulsion Program. G. Thornton, S. H. Minnich, and C. Heddleson—D. H. Culver, ed. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Feb. 28, 1962. Contract AF33(600)-38062 and AT(11-1)-171. 196p.

The Heat Transfer Reactor Experiment No. 1 is described. Design data are presented, including a general description of the test assembly, the nuclear characteristics of the reactor, fuel element thermodynamic characteristics, and the control system. The three series of test runs are also described and the test results summarized. The general objectives of Heat Transfer Reactor Experiment No. 1 were to demonstrate the feasibility of the direct air cycle system by operating a turbojet engine on nuclear power, to demonstrate the adequacy of reactor design features, and to evaluate aerothermodynamic and nuclear characteristics of the reactor for use in the design of militarily useful aircraft power plants. (auth)

14281 (CEA-2051) LA DETECTION DES RUPTURES DE GAINES DANS LES REACTEURS DE PUISSANCE FRANCAIS. (Burst Slug Detection System in French Power Reactors). J. Megy and A. Roguin (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 40p.

Presented at the Society of Instrument Technology Symposium, London, March 15, 1961.

Gas samples are taken from the reactor channels, and the short-lived fission products are electrostatically collected to be analyzed by a phosphor and photomultiplier system. The electrostatic collection and rotating electrode system used with the detector is described. Data processing equipment is designed and adapted to the detection apparatus, in order to make possible measurements of the evolution of the fission-product activity. The systems developed for the G1, G2, G3, EDF1, and EDF2 reactors are compared. (auth)

14282 (CEND-148) ABWR QUARTERLY PROGRESS REPORT, JULY 1–SEPTEMBER 30, 1961 [ON] DESIGN AND DEVELOPMENT. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Oct. 15, 1961. Contract AT(11-1)-1062. 100p.

In reactor development and evaluation, work is reported on minimization of the control rod drive mechanism, evaluation of PL-2 core lifetime, response of PL-2 type reactor to steam demand transients, and evaluation of fuel assembly and control system. In plant development and evaluation, work is reported on site adaptation, refueling, modifications to the turbine generator skid, and gaseous waste system. An experimental program is in progress to resolve the physics uncertainties in the PL core design. Activities in this program were centered around facility design and fabrication, experimental plans, calculations and support experiments, and evaluation of safeguards. In other work, the utilities and miscellaneous services within the SL-1 area were examined for potential use with a PL plant installation at NRTS. A summary of requirements based on complete razing of the SL-1 reactor building with appropriate restorations is presented. (J.R.D.)

14283 (DC-56-4-15) FUEL ELEMENT DEVELOPMENT IN THE EXPERIMENTAL MECHANICAL ENGINEERING UNIT, MILESTONE IV, TASK 7511. General Engineering Development Report No. 180. J. B. Conway (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 24, 1956. Contract [AT(11-1)-171]. 35p.

The fuel element development program is summarized for the period from January 1, 1954, to January 1, 1956. The types of fuel element failures obtained in burner rig tests are shown and explained. There appear to be seven fuel failure factors. It is recommended that future fuel element testing be planned to evaluate the integrity of the design with respect to these factors. It is also recommended that the burner rig test pattern for a particular fuel element design be set to match the performance profile (i.e. time at various dynamic heads and temperatures) of the intended reactor application. This type of testing should be applied only to those designs which have been subjected to burner rig screening tests and appear to have the greatest potential. (auth)

14284 (DC-57-7-177) OPERATION AND PERFORMANCE OF POWER RANGE SYSTEM AND CHANNEL SELECTOR CIRCUITRY; PROJECT 102 CONTROL SYSTEM. James E. Mott (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 23, 1957. Contract [AT(11-1)-171]. 76p.

The theory of operation, the calibration and test, the performance, the operating procedure, and typical circuit voltage readings for the power range system and the channel selector circuit of Project 102 are given. Schematic drawings, sketches, and photographs are included. (auth)

14285 (GA-2747) 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending September 30, 1961. (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Contract AT(04-3)-314. 162p.

Process improvement for preparation of ThC and UC particles is reported. Operation of the in-pile-loop at 57% of rated power was achieved on a staged approach to full power of 75 kw. Stability testing of rhodium and boron carbide in the HTGR core was completed. Calculations of power distributions and control rod worths were completed. Results show that the reactor can be shut down with no help from control rods other than those already in the core to maintain k = 1 in the hot, clean condition. Im-

proved designs led to reductions in over-all core temperatures. Partial completion of control-rod-drive testing at simulated reactor temperatures in He atmosphere is reported. A computer analysis of the fission-product trapping system performance under transient conditions showed that in the most stringent nonaccident conditions, a sharp pulse of heat-produced activity could originate in the first refrigerated delay bed and pass rapidly through the system. If the bed is bypassed, however, the remainder of the system is able to function satisfactorily throughout the depressurization. (J.R.D.)

14286 (GEAP-3785) NUCLEAR SUPERHEAT PROJECT EIGHTH QUARTERLY PROGRESS REPORT, APRIL–JUNE 1961. R. T. Pennington (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Contract AT(04-3)-189. 304p.

Studies on the use of erbium burnable poison in superheat fuel indicate that significant amounts of control can be accomplished which may result in acceptibility of gray control rods with associated reduction in maximum rod worth and power perturbations. Satisfactory performance of the SH-4 fuel elements during irradiation testing is reported. All experimental physics measurements in the VAL critical facility were completed during the period. Exposures for 500, 1000, and 2465 hrs were completed on type 304 stainless steel specimens under dynamic heat transfer conditions with controlled superheat environment. Measured corrosion rates are reported. In development work on the radial vane type primary steam separator, a full circle of radial vanes was found to operate with moisture carry-over of 6% and vapor carry-under of 0.2% by weight at about 20,000 ft^3/hr of 1000 psig saturated steam-water flow. Work was initiated on the design of a small prototype reactor to demonstrate the important features of a mixed spectrum superheater. Results of thermo hydraulics, nuclear physics, and safety aspects of fast core meltdown are reported. Completion of a preliminary hazards review for the Mixed Spectrum Superheater is also reported. (J.R.D.)

14287 (HW-65939) A MODEL OF THE PRTR MARK I FUEL ELEMENT FOR HEAT TRANSFER EXPERIMENTS. J. E. Hammond (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 6, 1960. Contract AT(45-1)-1350. 24p.

The design and construction are described of a full-scale, electrically-heated model of a 19-rod PRTR fuel element for use in heat transfer experiments. (J.R.D.)

14288 (KR-13) MECHANICAL DESIGN OF THE HBWR SECOND CHARGE CONTROL STATIONS. O. Egeland (Norway. Institutt for Atomenergi, Kjeller). Jan. 1962. 42p.

A description of the final mechanical design of the Halden Boiling Water Reactor second charge control stations is presented. The installation procedure is reviewed and a detailed discussion of specific design features is included. (J.R.D.)

14289 (MND-C-2487) PROCEEDINGS OF THE ANPP REACTOR ANALYSIS SEMINAR, OCTOBER 11-12, 1960. J. F. O'Brien, ed. (Martin Co. Nuclear Div., Baltimore). Jan. 1961. Contract [AT(30-1)-2345]. 304p.

The 14 papers presented at the Army Nuclear Power Program Reactor Analysis Seminar are given. Separate abstracts were prepared for each paper. (M.C.G.)

14290 (MND-C-2487(p.1-23)) PROBLEMS ASSOCIATED IN THE DESIGN OF A HIGH PERFORMANCE PRESSURIZED WATER REACTOR (SM-2). P. E. Bobe (Alco Products, Inc., Schenectady, N. Y.).

The major nuclear analysis performed during the development of a final design for the SM-2 is described. Fuel loading, reflector configuration, reactor vessel, core operating conditions, two-pass core, suppression of power peaks, and reactor control are discussed. (M.C.G.)

14291 (MND-C-2487(p.25-55)) PM-1 NUCLEAR DESIGN ANALYSIS. E. A. Scicchitano and R. A. Hoffmeister (Martin Co. Nuclear Div., Baltimore).

The methods and results of the core nuclear design analysis for the PM-1 are described. The analysis consisted of parametric studies, preliminary and final design, zero power test, and a design evaluation and analysis. Reactivity, reactivity transients, lumped burnable poison studies, core life studies, and control rod studies are discussed. (M.C.G.)

14292 (MND-C-2487(p.57-80)) STEADY-STATE REACTOR PHYSICS ANALYSIS OF THE ML-1 CORE. L. M. Maki and T. P. Wilcox (Aerojet-General Corp., Azusa, Calif.).

The ML-1 nuclear power plant, reactor core, and fuel elements are described. Steady-state core neutronics are discussed including design philosophy, fast constants, thermal constants, criticality, and gross power distributions. Intracell, radial, and axial power distributions were calculated. (M.C.G.)

14293 (MND-C-2487(p.81-101)) COMPARISON OF THEORY WITH THE OPERATING SL-1 REACTOR. H. Cahn (Combustion Engineering, Inc., [Windsor, Conn.]).

An evaluation of the SL-1 reactor was conducted to determine its operating capabilities in terms of its original design requirements. The nuclear characteristics of the "as-built" core were determined under cold, hot (zero-power), and full-power operating conditions. The treatment of the self shielding of boron and fuel is described in detail. Core reactivity, as computed using one- and two-dimensional diffusion theory calculations agreed with observation on SL-1 to within 2 to 3%. Lifetime calculations by both "window shade" and a first order synthesis are discussed and the results are presented. (auth)

14294 (MND-C-2487(p.103-21)) PREDICTION OF THE NUCLEAR CHARACTERISTICS OF THE SM-2 CORE. B. J. Byrne and B. E. Fried (Alco Products, Inc., Schenectady, N. Y.).

The methods used to predict the nuclear characteristics of the final SM-2 design are described. Most of the emphasis was placed on the empirical corrections used to force agreement between theoretical calculations and actual experimental data. Core lifetime calculations, temperature coefficient, determination of poison loading, control rod worth, and power distribution are discussed. (M.C.G.)

14295 (MND-C-2487(p.123-30)) ANALYSIS OF BOILING WATER REACTORS. L. C. Noderer (Combustion Engineering, Inc., [Windsor, Conn.]).

A brief review of pressurized water physics is presented since the problems in the analysis of a boiling water reactor include whatever problems are encountered in pressurized water reactors plus the presence of steam voids. Methods of analyzing the void distribution are discussed. A boiling water reactor thermal and hydraulic code called STREAC is described. A method of predicting stability for boiling water reactors by expressing the conditions in terms of the transfer functions of power to reactivity input is outlined. A transfer function code, TPF1, is described. (M.C.G.)

14296 (MND-C-2487(p.131-45)) HETEROGENEOUS CONTROL ROD STUDIES. B. W. Colston, E. E. Gross, and M. L. Winton (Oak Ridge National Lab., Tenn.).

The development of methods for handling control rods in

a heterogeneous core such as the NS Savannah is described. The cross sections for the three nonthermal groups were obtained by averaging basic data over a slowing-down flux spectrum resulting from a multigroup calculation of a volume-homogenized Savannah core. The neutron conservation equation was solved for the four-group fluxes. The eigenvalue results for various homogenization schemes are shown. A study was made of the effect on eigenvalue and power distribution of successively replacing diffusion-theory boundary conditions with logarithmic-derivative boundary conditions beginning with the thermal group. The energy distribution of absorptions in the NS Savannah control rods are shown. (M.C.G.)

14297 (MND-C-2487(p.147-60)) THE ARMY PRESSURIZED WATER REACTOR PILOT CODE. G. Cannon, E. A. Colbeth, D. Frederick, T. Olsen, E. Schaefer, and D. Wolf (Martin Co. Nuclear Div., Baltimore).

A Pilot Code was developed to predict most of the nuclear quantities of interest with only one trip to the digital computer and provide experience in combining the various physical models and machine programs necessary to determine each quantity of interest. The Pilot Code consists of the following basic parts: CELCOR for determination of one-dimensional and synthesized two-dimensional multigroup cell corrections for heterogeneity using SN transport theory, SYNFAR for determination of one-dimensional and synthesized two-dimensional few-group gross flux distributions and reactivity using P1 or SN transport theory, and SYBURN for determination of reactor lifetime using material depletion equations in automated combination results from the other two codes. FORTRAN was used to compile the Pilot Code. The code demonstrated that it is possible and practical to automate and combine many small physical models and computations. (M.C.G.)

14298 (MND-C-2487(p.161-85)) SOME RESULTS OF THE EXPERIMENTAL PROGRAM CONDUCTED IN SUPPORT OF APWRC. C. Eicheldinger and L. Welshans (Martin Co. Nuclear Div., Baltimore).

A program is being carried out to provide reliable, pertinent experimental data for use in analysis of pressurized water reactors. A series of clean core experiments were designed to study parametrically the behavior of fully enriched uranium, stainless steel, water-moderated cores. The critical assembly in which the experiments were conducted is described. Measurements were made of gross activation distributions along the three axes of the core and of fine thermal activation distributions within a unit cell. The temperature coefficient of reactivity, fuel and boron reactivity worths at various radial locations in the core, and the percent of fissions caused by sub-cadmium neutrons were determined. Pulsed neutron experiments were also performed. (M.C.G.)

14299 (MND-C-2487(p.187-202)) EXPERIMENTAL EVALUATION OF PL-2 DESIGN METHODS. W. B. Wright (Combustion Engineering, Inc., [Windsor, Conn.]).

Measurements were made in a four-by-six array of subassemblies containing UO_2 rods. Criticality was attained in each case at a partial water height with the control rods out of the core. Power distributions were obtained by gamma counting the fuel rods. The eigenvalues obtained from the PDQ-WANDA synthesis were compared with experimental results. Power maps are shown. (M.C.G.)

14300 (MND-C-2487(p.203-22)) ML-1 CRITICAL EXPERIMENTS. D. A. Dingee and J. W. Ray (Battelle Memorial Inst., Columbus, Ohio).

The ML-1 critical assembly is described. Experimental measurements in the critical assembly include the following: critical configurations of the ML-1 in dry and flooded conditions, power and neutron-flux distributions, effects of modified fuel assemblies, control-blade-worths, and temperature coefficients. Initial critical reactor configurations are shown. The effects of nonuniform fuel spacing on power flattening were determined. (M.C.G.)

14301 (MND-C-2487(p.223-31)) ANALYSIS OF REACTOR EXCURSIONS TERMINATED BY STEAM FORMATION. R. S. Stone (Oak Ridge National Lab., Tenn.).

Studies are being made to develop a quantitative picture of the mechanisms which determine reactor behavior at very short periods and to furnish a test for models developed from theoretical considerations. A model of the BSR-II, a stainless steel swimming pool-type reactor is described. The work on which such a model is based is shown. Shutdown following the fast insertion of a little over a dollar's worth of reactivity by the burst rod was assumed to come about from a combination of fuel and water temperature coefficients and from the expulsion of the moderator by the formation of steam. A plot was made of heat transfer rate versus integral power into the water. Some of the simulated power peaks achieved on the first run are shown. The 99.7% excursion agreed quite well with the experimental peak height, but at shorter periods, the analog peaks dropped to about one quarter of the experimental value. (M.C.G.)

14302 (MND-C-2487(p.233-55)) FUEL ELEMENT TEMPERATURE PREDICTION AND OPTIMIZATION FOR ML-1. W. J. Houghton, R. J. Vetterlein, A. B. Burgess, and C. R. Fisher (Aerojet-General Corp., Azusa, Calif.).

A fuel element for the ML-1 reactor is described. The heat transfer characteristics for the core as a whole are given. Optimization to reduce the fuel element temperature and to assure that, in the ideal case, all pins would have the same peak temperature is discussed. A comparison of the heat transfer performance of different pin bundles is given. It is shown that increasingly smaller pins with more pins per bundle have an idealized temperature advantage. The optimization techniques gave all of the pins in the reactor a similar axial profile and nearly equal peak temperatures within the limitations of the heat spot problem. The theory and the analytical techniques used to predict fuel temperatures. Temperature predictions are presented and compared with experimental results. (M.C.G.)

14303 (MND-C-2487(p.257-94)) PREPOWER ZERO POWER REACTOR PHYSICS EXPERIMENTS ON THE ARGONNE LOW POWER REACTOR. D. H. Shaftman (Argonne National Lab., Ill.).

The Argonne Low Power Reactor core design is described. The pre-experiment motivations for the core design selected are outlined. Certain aspects of the reactor physics of preliminary core loadings are discussed. Zero power experiments on the basic, reference reactor are summarized. Data from experiments on loadings as large as 59 assemblies are included. (M.C.G.)

14304 (MND-M-1858) PM-1 CRITICAL EXPERIMENTS AND ZERO POWER TESTING. (Martin Co. Nuclear Div., Baltimore). Sept. 1961. Contract AT(30-1)-2345. 389p.

Critical experimentation was performed for the design of the PM-1 reactor core, providing two types of information: design data pertaining to the cold, new and clean core, and data with which to evaluate and, if necessary, improve the analytical techniques available for the prediction of operating core characteristics. The experimental effort com-

prising the PM-1 Zero Power Test Program (PMZ-1) was divided into the following five groups: minimum size critical core, initial configuration studies, studies for the selection of the reference design configuration, reference design configuration studies, and miscellaneous measurements. Investigations of control characteristics, core reactivity, power distribution and temperature coefficient were conducted. The reactivity of the cold, clean reference design configuration was found to be 13.3%. This reactivity is controlled with a bank of six rods, five of which are worth 13.7% in reactivity, providing a five-rod bank shutdown margin of about 0.4% in reactivity. The analytical effort consisted of the following areas of investigation: critical mass studies with and without lumped poison rods; core reactivity studies, including the effects of spectral hardening, heterogeneities, neutron age, and temperature; control rod studies; studies of power distribution; and miscellaneous design studies. It was shown that analytically determined total core reactivities contained a bias of about 1.5%, and that early calculations of rod worths differed from measured values by as much as 25%. It was shown experimentally, however, that the control requirements for the PM-1 core are satisfied for the most reactive core condition, namely, at the start of life in the cold, clean condition. Subsequent work indicated that substantial improvement in rod worth calculations would be obtained from the use of Blackness Theory and an improved geometrical representation of the Y-rods. This later work further indicated that the reactivity bias can be attributed almost entirely to the slowing-down model employed in the reactivity calculations. (auth)

14305 (NAA-SR-Memo-2188) SRE CONTROL ROD SHIELDING REQUIREMENTS. H. O. Whittum (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 22, 1957. Contract [AT(11-1)-Gen-8]. 18p.

Data taken on radiation traverse of the Mark I control rod were analyzed. Future radiation levels for all SRE control and safety rods were predicted from this. The shielding necessary to ship a complete rod and that necessary to protect a person doing maintenance work on these rods were calculated. The unshielded gamma dose rate 1 cm from the surface of the most highly activated portion of the control rod was calculated to be 5.0×10^4 r/hr 14 days after shutdown following an extended power run of 90 days duration. (M.C.G.)

14306 (NAA-SR-Memo-2919-1) FAST SCRAM INSTRUMENT FOR THE OMR CRITICAL EXPERIMENT. Addendum 1. L. S. Beller (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 7, 1961. Contract [AT-11-1-GEN-8]. 12p.

A gamma-sensitive safety instrument for critical experiments is described which responds to a scram condition in less than five milliseconds. It was intended as a backup device having considerably faster response than conventional operating instruments. Twelve such instruments were used for some time on critical experiments. The experience with these instruments to date is summarized and recommendations are made for changes intended to enhance the reliability, stability, and ease of adjustment. The possibility of using the instrument as a reliable remote-area neutron or gamma monitor is discussed. (auth)

14307 (NAA-SR-Memo-4093) STEADY STATE THERMAL BEHAVIOR OF HNPF SODIUM HEAT TRANSFER SYSTEM. A. T. Stell (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 10, 1959. Contract [AT-11-1-GEN-8]. 92p.

The performance of the Hallam Nuclear Power Facility heat transfer components was investigated in order to determine the steady-state, part load characteristics under various operating conditions. The complete steady-state temperature distributions, variations of flow rates and heat transfer coefficients throughout the sodium heat transfer systems as functions of reactor load are shown in a series of graphs. (M.C.G.)

14308 (NAA-SR-Memo-4824) CONVECTION CONTROL ANALOG STUDY. R. E. Fortier and E. H. Clark (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 11, 1960. Contract [AT-11-1-GEN-8]. 136p.

An analog model and basic physical equations were developed for a convection flow control system. The model was developed for the controller, core, coolant piping, hydraulics and heat transfer, and intermediate heat exchanger based on specifications and previously developed analytical models. The physical equations and the assumptions made in the model are listed. The computer testing program is described, and the scaled equations used in the simulation are given. The system transient characteristics during plant startup from afterglow power levels were determined. The nature of core and external system transients for some time following a scram were also calculated. (M.C.G.)

14309 (NAA-SR-Memo-6954) STABILITY AND PERFORMANCE OF THE HNPF FEEDWATER AND PLANT POWER CONTROL SYSTEMS. R. L. Detterman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 15, 1961. Contract AT(11-1)-Gen-8. 49p.

Analog studies demonstrated that the Plant Power Control System can maintain throttle pressure at ±2 psi for ramp changes in steam flow of 15% per minute. This steam flow rate of change is about twice that specified to meet the design load swing of 5 Mwe/min. The positive feedback introduced into the control loop by the steam flow programming signal did not greatly affect the pressure control system performance. It was found that this system will not exhibit instability as a result of the steam flow program signal. For ±10% step changes in sodium flow, over the flow range from 20 to 100% rated, the control system will regulate throttle pressure with a maximum error of ±18 psi. The recovery rate is relatively fast reducing the pressure error to ±5 psi in less than 1.5 minutes. A ±50°F change in sodium inlet temperature produces a maximum pressure error of ±15 psi. The feedwater flow responds rapidly to changes in valve position. For the open loop valve positioning system, the 180° phase point occurs at about 2 radians per second. The high full flow gain of the present equal percentage control valve will result in control system instability unless the controller proportional band is greater than about 350. Since the present controller has a maximum proportional band of 500, and the accuracy in the upper ranges is rather poor, the present system will exhibit instabilities at all controller settings. The equal percentage valve also results in a gain change of 28 decibels from 100 to 20% rated feedwater flow. These two difficulties may be overcome by changing the valve internals to those characteristic of a 3-in. valve and changing the flow signals from the flow squared inputs to the easily available linear inputs. This system will respond rapidly to changes in feedwater pump pressure steam flow, and evaporator pressure. The level control system is rather sluggish due to the inherent low system gain. To improve system performance it is recommended

that a feedwater supply pressure of 1000 psi be established as the set point of the feedwater pump system. (auth)

14310 (NYO-9614) CYCLIC TEST ON N. S. SAVANNAH REACTOR VESSEL MODEL. Thomas Stilwell and Kenneth R. Stearns (Franklin Inst. Labs. for Research and Development, Philadelphia). Sept. 1961. Contract AT(30-1)-2129. 106p. (F-A2150-2)

Tests on the quarter-scale model of the N. S. Savannah Reactor Vessel under cyclic loading conditions were successfully concluded. The investigation was specifically directed to the outlet nozzle area because of the results of static tests. Pressurization to 3000 psi (150% of design pressure) had caused yielding on the inside surface of the outlet nozzle. Continuous strain data were obtained at 38 locations for 3000 cycles of the simultaneous application of the maximum design pressure of 2000 psi, together with the most severe piping reactions expected. The highest strains, as in the previously conducted static tests, occurred on the inner surface of the outlet nozzle along the top and bottom vertical sections. Major inspections were made at the following number of cycles: 0, 250, and 3000. These included visual, dye penetrant, and magnetic particle inspection at both internal and external surfaces in the region of the outlet nozzle. Visual inspections of the external surface only, were also made at 1000 and 2000 cycles. No indications of fatigue failure were noted by either the inspections or strain records. The test facility provided automatic cycling of pressure and nozzle loads, automatic recording of the strain records, and fail-safe characteristics in case of malfunction. Descriptions of test facility and procedure are presented. A discussion of fatigue damage and a set of source data are included. Two internal flaws were discovered in the weld joining the nozzle to the shell when an x-ray was made prior to the cyclic tests. It was concluded that the flaws were missed on the original x-ray examination of the completed vessel. It was further concluded that the tests should be continued because the flaws were in a plane of low stress. No problems developed from these flaws. Despite high local strain, the results of these tests confirm the structural adequacy of the outlet nozzle region. Also, because stresses throughout the rest of the vessel were found to be well below the yield point of the material (Report NYO 2856), it can be concluded that all areas of the reactor vessel are structurally adequate. (auth)

14311 (ORNL-2867(Rev.)) NUCLEAR MERCHANT SHIP REACTOR FINAL SAFEGUARDS REPORT. ENVIRONMENTAL ANALYSIS OF NS "SAVANNAH" OPERATION AT CAMDEN. W. B. Cottrell, L. A. Mann, F. L. Parker, and G. D. Schmidt (Oak Ridge National Lab., Tenn.). Jan. 24, 1961. Contract W-7405-eng-26. 140p.

An analysis is presented of the possible accidental release of activity following operation of the NS Savannah at Camden, N. J. In a maximum credible accident the resulting exposure does not exceed the proposed emergency criteria, and it is concluded that exposures ensuing from potential accidents following operation of this ship reactor should not cause any undue hazard. (J.R.D.)

14312 (ORNL-3238) MARITIME REACTOR PROGRAM ANNUAL PROGRESS REPORT FOR PERIOD ENDING NOVEMBER 30, 1961. (Oak Ridge National Lab., Tenn.). Mar. 9, 1962. Contract W-7405-Eng-26. 118p.

Progress is reported on general support of the NS Savannah, operation of the pressurized-water in-pile loop, and advanced core development. A shield survey, iodine adsorption studies, a bioassay development program, preparation of replacement control rod drives, irradiation testing of pressure-vessel steel, a thermal insulation investigation, and an analysis of primary system components for gamma-emitting elements were carried out in the NS Savannah program. Water-chemistry studies in the pressurized-water in-pile loop were made to determine the specific activities and the chemical compositions of filterable and nonfilterable impurities in the loop water. Fuel development and irradiation tests and core I lifetime studies were carried out in the NS Savannah advanced core development. (M.C.G.)

14313 (ORNL-TM-134) EGCR EXPERIMENTAL LOOPS, PRELIMINARY DESIGN REPORT. F. H. Neill and C. Michelson (Oak Ridge National Lab., Tenn.). Mar. 27, 1962. Contract W-7405-Eng-26. 311p.

The EGCR was designed to accommodate up to four gas-cooled experimental loops plus several experimental fuel elements in the open core. Two of the loops will utilize 5½-in.-O.D. stainless steel tubes passing through the core along an axis which is about 17 in. from the central axis of the core. The other two loops will utilize 9½-in.-o.d. tubes about 68 in. from the central axis. Inherent safety in the design, facility design, primary loop design, auxiliary systems and equipment design, primary and secondary containment design, instrumentation and controls, and special operations are discussed. (M.C.G.)

14314 (OSB-15) PRELIMINARY INVESTIGATION OF SM-1 CONTROL ROD SEAL FAILURE. G. W. Knighton (Corps of Engineers. Nuclear Power Field Office, Fort Belvoir, Va.). Apr. 18, 1961. 20p. (AD-259803)

The control rod drive seal leakage rate was observed to rise to 9 times its normal value. Two seals were replaced by rebuilt assemblies, thus reducing the leakage rate to an allowable operating rate. Plugging was observed in the seal of shim #3, and was eliminated by back flushing. Visual inspection indicated that the leakage increase was caused by increased clearance, which in turn was probably caused by overheating due to loss of cooling water at various times during the operating period. (auth)

14315 (PRDC-TR-52) MONTHLY TECHNICAL REPORT [ON FERMI REACTOR], OCTOBER 1961. (Power Reactor Development Co., Detroit). Contract AT(11-1)-476. 22p.

Sub-assemblies for use in Fermi reactor Core A low-power operation are described. The Core B irradiation program is outlined and calculations on temperature coefficients in a Core B scram are presented. Graphite testing was conducted to determine the efficiency of water removal in vacuo by heating. Other graphite samples were irradiated at high temperature. Assembly procedure refinements are being made for Core B. Nuclear engineering activities include safety studies, Core A phyics studies, and shielding requirements studies. Plans for preoperational tests of the neutron detectors are outlined. Developments in instrumentation and in the liquid metal and steam systems are reviewed along with tests results for various components and systems. (J.R.D.)

14316 (PREDC-3079) RADIATION MEASUREMENTS AROUND THE P102 CORE DURING THE CRITICAL EXPERIMENT (MIDPLANE GAMMA AND FAST NEUTRON). G. Tuck (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 29, 1958. Contract [AT(11-1)-171]. 16p.

Measurements of gamma radiation and fast neutron dose rates made in the water tank on top of the P102 dolly during a critical experiment are reported. Data are presented graphically. (J.R.D.)

14317 (TID-15057) THE GENERAL ELECTRIC 100 MEGAWATT NATURAL CIRCULATION BOILING WATER REACTOR POWER PLANT. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). [1960]. Contract [AT(04-3)-189]. 63p.

A technical description is presented of a 100-Mw(e) nuclear power plant using a natural-circulation, internal-steam-separation boiling-water reactor to furnish steam to one turbine-generator. (D.L.C.)

14318 (TID-15063) MONTHLY OPERATING REPORT, JANUARY 1962. VOLUME V, ISSUE 1. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 50p.

The Shippingport Atomic Power Station generated power continuously throughout January, maintaining an average output of almost 61 Mw net. This increase of almost 1 Mw was due to a reduction in station service load. The 1C reactor coolant loop was removed from service because of an alarm indicating a reactor coolant loop valve drift. Water conditions were maintained within reference specifications. Radiation and contamination levels remained low except in three areas. Those areas were successfully decontaminated. (M.C.G.)

14319 (WAPD-R(TH)-604) RESULTS OF FRICTIONAL PRESSURE DROP TESTS ON PWR-2 BLANKET ISOSTATIC BONDED URANIUM OXIDE FUEL PLATES. W. H. Bell and B. W. LeTourneau (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 22, 1960. Contract AT(11-1)-gen-14. 11p.

The surfaces of PWR-2 isostatic bonded uranium oxide fuel plates are of such a nature that their frictional pressure drop characteristics may deviate significantly from the pressure drop characteristics of smooth plates. Frictional pressure drop tests were conducted on four PWR-2 blanket fuel plates assembled in a test apparatus with plate separations (channel thicknesses) of 0.080- and 0.200-in. Results of tests with both the 0.080- and 0.200-in. channel thicknesses showed that for Reynolds numbers in the range of 20,000 to 160,000 the frictional pressure drop for the oxide plates was 10 to 12% higher than for smooth plates. (auth)

14320 (XDC-59-11-94) FUEL ELEMENT NUCLEAR DESIGN PROGRAM. C. S. Robertson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 26, 1959. Contracts AT(11-1)-171; AF33(038)-21102; and AF33(600)-38062. 35p.

ANP 704 digital program No. 381, which was used to perform the bulk of the nuclear calculations for the D103A fuel element design is described. This program handles the iterative fine power flattening of concentric ring fuel elements of the D103A type. Input consists of gross element geometry, basic nuclear data and various mechanical parameters. Output consists of the fine geometry of the element, the fine power profile, and partially processed thermodynamic data. The thermodynamic data are also punched in a form suitable for use as input to ANP program No. 23, Flow Through Heated Annuli. (auth)

14321 (XDCL-59-9-725) DATA REPORT FOR GE-ANP-1B2 SAMPLE. D. C. Foster, D. J. Liffengren, D. Martin, and F. L. Sims (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 22, 1959. Contract [AT(11-1)-171]. 99p.

The GE-ANP-1B2 sample, a P-102 production design fuel element, was tested in the HT-1 facility of the MTR. The fuel element was enclosed in a boron steel liner and consisted of eight stages, six of which were fully enriched U and two depleted fuel stages. The enriched stages contained identified defective areas termed blisters which are typical of production defects. The sample was tested for 100 hours at 1850°F for the evaluation of the effect of the blisters on the integrity of D102A reactor elements and no fission product release was detected. (auth)

14322 (XDCL-60-3-176) TRIP REPORT—GAS-COOLED REACTOR SYMPOSIUM, FEBRUARY 10-11, 1960, THE FRANKLIN INSTITUTE, PHILADELPHIA, PENNSYLVANIA. J. H. Guill (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 14, 1960. Contract [AT(11-1)-171]. 83p.

A trip report is presented in which a summary is given concerning the status of the gas-cooled reactor programs as presented at a symposium on the subject. Emphasis at the symposium was placed on engineering problems. (J.R.D.)

14323 (YAEC-132) TRANSIENT BOILING BEHAVIOR OF THE YANKEE REACTOR FOLLOWING LOSS OF COOLANT FLOW. J. P. Cunningham, J. M. Gallagher, Jr., and T. Gogniat (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). July 1961. For Yankee Atomic Electric Co., Boston. Contract AT(30-3)-222, Subcontract No. 1. 62p.

A study was performed to determine the consequences of a complete and simultaneous loss of power to all the main coolant pumps of the Yankee reactor during full power operation. The neutron kinetics equations, including feedback effects and scram, and the heat transfer equations in a three-section hot channel and in the average channel were solved on an analogue computer. Coolant conditions in the hot and average channels were calculated as functions of time and position by use of the CAT digital computer code for open lattice cores. The solutions were iterated to convergence, to determine the time and location of departure from nucleate boiling. Analogue calculation of the hot spot clad temperature before and during film boiling indicated that the clad temperature would not exceed 1430°F. Since this is well below the annealing temperature of 1875°F, at which clad rupture would occur, there is no danger of clad rupture. A later review of the analysis led to changes in several major assumptions. A re-evaluation of the accident with these modifications did not change the conclusion. (auth)

14324 CONDITIONS FOR USING REACTOR TRANSFER FUNCTIONS. Pavel Kovanic (Inst. of Nuclear Studies, Czechoslovak Academy of Sciences, Prague). Atomnaya Energ., 12: 123-8(Feb. 1962). (In Russian)

The reactor transfer functions which are needed for the solution of automatic control of the power demand, the startup period, and other important reactor problems, being determined by kinetic equations do not describe completely the dynamic behavior of the reactor. They are applicable only under specified conditions. The equivalent complex multiplication coefficient of the reactor may be determined not only by the change of the input but also by the output. Equations were derived permitting the programmatic regulation of the period and the power level, making it possible to determine the conditions involved in the change of the transfer functions. The system derived also allows estimation of the level of possible errors. New formulas have been obtained for subcritical, prompt critical and supercritical reactor systems. The new set of functions yields more accurate results than the equations obtained by H. Sandmeier (Nuclear Sci. and Eng., 6: 85 (1959)). (TTT)

14325 CRITICALITY TESTS ON A HEAVY-WATER REACTOR EXPERIMENTAL STAND WITH ROD-SHAPED

FUEL ELEMENTS. Yu. G. Abov, V. F. Belkin, and P. A. Krupchitskiĭ. Atomnaya Energ., 12: 156-9(Feb. 1962). (In Russian)

In view of the difficulties arising from the calculation of criteria of porous fuel elements used in power reactors, a critical test assembly was constructed in which the critical dimensions of rod-shaped fuel elements designed for heavy-water reactors could be tested. The assembly was provided with a manual control system; emergency shutdown was accomplished by dropping the B scram rods and draining the heavy water from the tank. The critical dimensions of 5 fuel-channel designs were thus determined as a function of the lattice arrangement. The average weight of the used unclad rods was 793 ± 1 g with a U density of 18.8 g/cm^3. The critical values were determined by plotting the reciprocal counting rates of 4 neutron counters; the height of the water level was measured by a water gauge with a precision of ±1 mm. Results indicated that elimination of 20 channels from the design does not affect markedly the critical parameters. More detailed calculations based on the experimental data obtained allowed precise computations for proposed new reactor types. (TTT)

14326 CAVERN CONTAINMENT OF NUCLEAR POWER REACTORS. T. Leardini and M. Cadeddu (SADE, Venice). Energia nucleare (Milan), 9: 73-8(Feb. 1962). (In English)

Results of tests on the thermal behavior of a steel-sheet-lined cavern under hot steam conditions are reported. A calculation method for predicting after-accident temperature in a cavern-contained reactor is examined. This method was applied to two tests: one carried out in a concrete-lined cavern, the other in a steel-sheet-lined cavern. Indications on the reliability of the method were derived. (auth)

14327 THE "CAN" RESEARCH AND DEVELOPMENT PROGRAM ON THE APPLICATION OF STEAM-WATER MIXTURES TO THE REACTOR COOLING. S. Vil[illegible] (Laboratori CISE, Segrate, [Italy]). Energia nucleare (Milan), 9: 84-96(Feb. 1962). (In Italian)

Reactor cooling by means of steam-water mixtures in dispersed flow is very promising on the basis of available data. A research and development program being conducted to obtain additional information on this method of cooling is described. (L.N.N.)

14328 PRESTRESSED CONCRETE PRESSURE VESSELS. S. Gill and I. W. Hannah (Simon-Carves Ltd., [Eng.]). Nuclear Power, 7: No. 71, 48-50(Mar. 1962).

The pros and cons of using prestressed concrete pressure vessels, based on observations of model tests, for the next British nuclear power station are reviewed. The characteristics, present development, and design methods are considered. The results indicate that the prestressed concrete pressure vessel is more practicable, safe, and economical than the steel vessel. (N.W.R.)

14329 SUPERHEATER DESIGN FOR BOILERS IN GAS-COOLED REACTORS. B. G. Ediss (Nuclear Chemical Plant Ltd. [Eng.]). Nuclear Power, 7: No. 71, 55-9 (Mar. 1962).

A technique is described that greatly simplifies the laborious methods of superheater design, at the same time giving increases in over-all cycle efficiency without additional cost. The technique is supplemented by data on the Latina superheater. (N.W.R.)

14330 STATISTICS AND THE ESTIMATION OF DESIGN DATA—2. A. N. Knowles (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Nuclear Power, 7: No. 71, 65-9(Mar. 1962).

Statistical methods for estimating nuclear plant design data are described and applied to several examples. Applications outlined include pressure tests, rupture tests, and the design of strain gage installations. (N.W.R.)

14331 BRADWELL NUCLEAR POWER STATION. Nuclear Power, 7: No. 72, 78-105(Apr. 1962).

A review is given on some important findings from the building of the Bradwell Nuclear Power Station. Discussion is given on: core and fuel handling, which includes construction and forced changes in fuel elements and graphite structure; primary circuit, which includes materials problems and leak tightness in design and construction of the pressure vessel, ducting, valves, circulators, and heat exchangers; final installation of instrumentation and controls; turbine hall and switchgear, including main and auxiliary turbo-generators, substation, and plant house; and standard and special components in ancillary equipment. A detailed list of the British companies who participated in the construction of Bradwell is given. (P.C.H.)

14332 THE CONSTRUCTION OF THE EXPERIMENTAL ATOMIC POWER PLANT AT KAHL. Fritz Boernke (Rheinisch-Westfälische Elektrizitätswerk A. G., Essen). VDI Zeitschrift, 104: 89-100(Jan. 21, 1962). (In German)

The construction of the 15-Mw experimental station at Kahl, Germany is described. The techniques used in the construction of the following main components are given special emphasis: reinforced concrete reactor building, cylindrical reactor pressure vessel (concrete encased steel shell), a specially protected steam transformer to the secondary steam generating unit, and reinforced concrete preparation building for the storage of fuel and the elimination of activities. The reactor building has a caisson foundation for protecting against flooding and ground water. The reactor shielding walls are made of 3 m thick boron concrete and heavy concrete inserts. (N.W.R.)

14333 NUCLEAR POWER PLANTS AND MOBILE NUCLEAR POWER STATIONS. Guenter Wiesenack (Technische Uberwachungs-Vereine, Essen, Ger.). VDI Zeitschrift, 104: 179-82(Feb. 1, 1962). (In German)

A brief review is given of general technical problems, safety and special incidents, stationary nuclear power plants, mobile nuclear power plants, and research reactors for studying economic methods for producing power. The bibliography contains 54 references. (N.W.R.)

14334 IMPROVEMENTS IN OR RELATING TO METHODS OF OPERATING GAS COOLED NUCLEAR REACTORS. Jack Moore and David William Williams (to United Kingdom Atomic Energy Authority). British Patent 891,804. Mar. 21, 1962.

A method is given for operating a gas-cooled reactor so that short-lived fission products are forced from leaking fuel elements into the coolant stream for detection with a fuel element leak detector apparatus. In the method, the pressure is reduced in the coolant circuit at low power, and the reactor is scanned with the apparatus. An example of the method is given for a CO_2-cooled reactor normally operated at 90 psig and 200 Mw. (D.L.C.)

14335 IMPROVEMENTS IN NUCLEAR REACTOR VAPOUR GENERATING AND POWER PLANT AND AN IMPROVED METHOD OF GENERATING VAPOUR UNDER PRESSURE. William Robert Wootton (to Babcock & Wilcox Ltd.). British Patent 891,852. Mar. 21, 1962.

A vapor-generating power plant is designed for use with a gas-cooled reactor. The power consumed by the compressor is reduced by cooling the gaseous coolant entering the compressor to a temperature below that of the coolant entering the reactor. Means is provided in the economizer

surfaces of the vapor generator to raise the temperature of the coolant flowing from the compressor to the reactor by heat exchange with partially cooled coolant flowing to the compressor. A separate, fuel-fired superheater is also provided. (D.L.C.)

Research Reactors

Refer also to abstracts 14062, 14068, and 14077.

14336 (APED-3855) NUCLEAR TEST REACTOR—VALLECITOS ATOMIC LABORATORY. Walter V. Mosgovoy (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Nov. 13, 1961. For General Electric Co. Atomic Power Equipment Dept., San Jose, Calif. 27p. (R61APE-95)

The services available at the Vallecitos Atomic Laboratory in the 30-kw Nuclear Test Reactor are described. The reactor description includes the core assembly, reel assembly, fuel sub-assembly, storage tank, graphite moderator, coolant system, source system and control instrumentation system. (M.C.G.)

14337 (CEA-2005) EXPERIENCE INTERNATIONALE DE DOSIMETRIE SUR LA PILE DE PUISSANCE NULLE DE L'INSTITUT BORIS KIDRIC DE VINCA (YOUGOSLAVIE). CONTROLE, SECURITE, MANIPULATION DE L'EAU LOURDE, EXPLOITATION DE LA PILE DE PUISSANCE NULLE PENDANT LES EXPERIENCES. (International Dosimetry Experiment on the Zero Power Pile of the Boris Kidric Institute at Vinca (Yugoslavia). Control, Safety, Manipulation of Heavy Water, Study of Reactor at Zero-Power during the Experiments). J. Weill, J. Furet, J. Baillet, G. Donvez, J. Duchene, R. Gras, R. Mercier, J. Chenouard, and J. Lecomte (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 34p. (SAER-1344/906)

The measurement and security apparatus installed on the pile for low- and high-pressure runs are described, as well as the safety equipment added near the control room. Various operations and manipulations are described, including filling the pile with heavy water, startup, determination of the critical level, testing the efficiency of the rods, and pile operations during the experiments. (auth)

14338 (DC-59-8-174) WATER CENTERING DATA WITHIN THE OTT. L. K. Zoller (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 21, 1959. Contract AT(11-1)-171. 21p.

An analysis is presented of the experimental water centerline data taken inside the test specimen compartment of the General Electric Outside Test Tank. These data were obtained in conjunction with a Ground Test Reactor core correlation study. (auth)

14339 (IDO-16745) SPERT IV FACILITY. R. E. Heffner, E. L. Morris, D. T. Jones, D. R. Seaman, and M. K. Shane (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 22, 1962. Contract AT(10-1)-205. 147p.

The Special Power Excursion Reactor Test IV (Spert IV) reactor is a swimming-pool type nuclear research reactor which was constructed to provide a facility for conducting reactor kinetic behavior and safety investigations especially in the field of reactor stability. The facility was designed to incorporate a wide range of flexibility in flow rates and direction of flow, and has a heat removal capacity of 1 Mw thermal in addition to the heat sink capacity of the reactor pools. The engineering features of the reactor and supporting process equipment as constructed at the National Reactor Testing Station are described. (auth)

14340 FAST-NEUTRON ENERGY SPECTRUM AND THERMAL NEUTRON DISTRIBUTION IN THE BEAM HOLE OF THE VVR REACTOR. N. V. Zvonov, A. I. Mis'kevich, I. V. Rogozhkin, V. I. Tereshchenko, Zh. I. Turkov, and V. P. Utkin. Atomnaya Energ., 12: 116-22(Feb. 1962). (In Russian)

The neutron flux and energy spectrum are often determined by activation analysis; this method was used by employing threshold reactions for examining the flux of the VVR-2 reactor. The γ-active nuclei formed were analyzed by means of a system consisting of a NaI(Tl) scintillation counter, a photomultiplier and a 100-channel pulse-amplitude analyzer. The γ radiation induced by the (n,p) reaction in Al, Fe, Si, Ti, Ni, Co, Mg, Zn, and Cu, and by the (n,α) reaction in Al and the (n,n') reaction in In, Hg, Pb, Ag, and Ba, was used for measuring the energy distribution of fast neutrons in the vertical beam hole of the reactor, in the vicinity of the core. The integral fast neutron flux thus determined is represented by a diagram. The thermal-neutron flux in the center of the 130-cm wide beam hole was found to be $4.5 \cdot 10^{11}$ n/cm^2 sec when the reactor was operated at 100 kw. Comparison of the data with previous calculations indicated that the thermal neutron flux in water vs. distance from core has the same characteristics as the similar function with concrete. (TTT)

14341 MTR–ETR OPERATING EXPERIENCE. R. L. Doan (Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Sci. and Eng., 12: 23-32(Jan. 1962).

The MTR completed its ninth year of successful operation on March 31, 1961. During this period the reactor was operating at design power, or better, approximately 70% of the time, for a total cumulative thermal energy production of 82900 megawatt days. The operating power level, originally designed for 30 Mw thermal, was raised to 40 Mw in 1955. Although normally operating on a fully enriched uranium core, the MTR has also operated successfully for one fuel cycle on a 20% enriched core and a plutonium core. A total of 10500 individual irradiations was performed in the MTR under AEC sponsorship and 986 under commercial programs. The Engineering Test Reactor was in successful operation at full design power of 175 Mw thermal for approximately three years, except for down-time occasioned by loop installations, experiment insertions and removals, and refueling. Total accumulated energy production to March 31, 1961, was 80900 Mw-days. Installation of major in-core loops is expected to be essentially complete by the end of 1961. A total of 1215 individual irradiations was performed in the ETR under AEC sponsorship and 21 under commercial programs. Roughly 41% of the $7,841,000 MTR–ETR program costs for FY 1960 were associated with the civilian reactors program, 40% with classified programs, and 3% with privately financed irradiations. The remaining 16% represents general research and development activities and radioisotope production. Approximately 700,000 c (curies) of radiocobalt were produced in the MTR–ETR, mostly in the 20 to 50 c/g range. Highest specific activity produced thus far is 308 c/g. No serious reactor incident was encountered in either the MTR or ETR, and there were no serious overexposures of personnel to radiation. The basic operating philosophy is implemented by a continuously functioning safeguard review board with power of veto over all reactor operations; careful operator training and supervision; firm instructions to all operators that the reactors are to be scrammed

promptly whenever any of the instrumentation or circuitry indicates abnormal behavior; prohibition against operating either reactor with any significant defects in control instrumentation, fuel elements, or shim rods; and strict limitations on permissible departures from standard operating parameters and procedures by reactor operators. (auth)

14342 THE BUILDING OF THE FIRST REACTOR OF THE NUCLEAR RESEARCH PLANT AT MUNICH-GARCHING. Erwin Ambach (Wayss & Freytag KG, Frankfurt am Main). VDI Zeitschrift, 104: 104-14(Jan. 21, 1962). (In German)

The construction details are given for a reactor with a reinforced concrete basin 14.22 m long, 5.90 m wide, and 10.35 m high. The reactor is erected in a reinforced concrete rotation bowl, the walls and roof of which form a single unit. The most satisfactory composition for the aggregated, barite-containing concrete, was determined by materials testing. The problems of reinforcing the reactor basin, accurately fitting and sealing the steel tube ducts, and pouring and compacting the heavy concrete are discussed. (N.W.R.)

14343 DIRECTORY OF NUCLEAR REACTORS. VOLUME II. RESEARCH, TEST AND EXPERIMENTAL REACTORS. (International Atomic Energy Agency, Vienna). 1959. 358p. (STI/PUB/9) $3.50

A directory of research, test and experimental reactors is presented. The reactors are grouped according to moderator under the following headings: light-water-moderated, pool-type research reactors; light-water-moderated, tank-type reactors; liquid-homogeneous-research reactors; solid-homogeneous-research reactors; heavy-water-moderated research reactors; graphite-moderated research reactors; and organic-moderated research reactors. (M.C.G.)

14344 POOL TEST REACTOR. p.35-40 of "Directory of Nuclear Reactors. Vol. II. Research, Test and Experimental Reactors." Vienna, International Atomic Energy Agency, 1959. (STI/PUB/9(p.35-40) AECL-1331). $0.20 (AECL).

Design information on the Pool Test Reactor is presented. Data are given on reactor physics, core, fuel elements, core heat transfer, control, reactor vessel, fluid flow, reflector and shielding, containment, and cost estimates. Drawings are included for fuel elements, core tube, vertical section, horizontal section, and fluid flow. (M.C.G.)

14345 NUCLEAR POWER DEMONSTRATION STATION. p.97-102 of "Directory of Nuclear Reactors. Vol. I. Power Reactors." Vienna, International Atomic Energy Agency, 1959. (STI/PUB/4(p.97-102) AECL-1330).

Information is presented on the NPD Reactor. Data are given on reactor physics, the core, core heat transfer, control, the reactor vessel, fluid flow, reflector and shielding, containment, and cost estimates. Drawings are presented of the fuel element subassembly, coolant tube assembly, reactor arrangement, and fluid flow in the reactor and turbo-generator. (M.C.G.)

14346 NRX-REACTOR. p.251-6 of "Directory of Nuclear Reactors. Vol. II. Research, Test and Experimental Reactors." Vienna, International Atomic Energy Agency, 1959. (STI/PUB/9(p.251-6) AECL-1332). $0.20. (AECL).

Design information is presented on the NRX Reactor. Data are given on reactor physics, the core, fuel elements, core heat transfer, control, reactor vessel, fluid flow, reflector and shielding, containment, cost estimates, and research facilities. Drawings of the vertical and horizontal reactor sections and fluid flow are included. (M.C.G.)

14347 ZERO ENERGY EXPERIMENTAL PILE. p.253-4 of "Directory of Nuclear Reactors. Vol. III. Research, Test and Experimental Reactors." Vienna, International Atomic Energy Agency, 1960. (STI/PUB/22 (p.253-4); AECL-1334). $0.10(AECL).

Design information on the Zero Energy Experimental Pile including a drawing of the vertical section are given. (M.C.G.)

14348 CANADA-INDIA REACTOR. p.281-6 of "Directory of Nuclear Reactors. Vol. III. Research, Test and Experimental Reactors." Vienna, International Atomic Energy Agency, 1960. (STI/PUB/22(p.281-6); AECL-1335). $0.20(AECL).

Design information on the Canada-India Reactor is presented. Data are given on reactor physics, the core, fuel elements, core heat transfer, control, reactor vessel, fluid flow, reflector and shielding, containment, cost estimates, and research facilities. Drawings of vertical and horizontal sections of the reactor and fluid flow are included. (M.C.G.)

14349 NRU REACTOR. p.301-6 of "Directory of Nuclear Reactors. Vol. II. Research, Test and Experimental Reactors." Vienna, International Atomic Energy Agency, 1959. (STI/PUB/9(p.301-6) AECL-1333). $0.20 (AECL).

Design information on the NRU Reactor is presented. Data are given on reactor physics, fuel elements, the core, core heat transfer, control, reactor vessel, fluid flow, reflector and shielding, containment, cost estimates, and research facilities. Drawings for a fuel element, horizontal reactor section, and fluid flow are included. (M.C.G.)

SPACE APPLICATIONS AND TECHNOLOGY

Refer also to abstract 13860.

14350 (GA-3007) INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS. Quarterly Progress Report No. 3, December 1, 1961 through February 28, 1962. A. F. Weinberg, R. G. Hudson, B. Siefner, and L. Yang (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Contract NAS 5-1253. 61p.

The physicochemical properties of mixed carbides of uranium and zirconium are being measured to determine the usefulness of these materials as nuclear-heated thermionic emitters or as the nuclear fuel for refractory-metal thermionic cells. Vapor-loss data, as determined by the Langmuir free-evaporation technique in the temperature range from 2130° to 2400°K, for three separate specimens with ZrC contents in the range from 81 to 86 mol-% ZrC can be expressed as follows: $\log \dot{w} = 8.3 - 3.03 \times 10^4(1/T)$, where $\dot{w}$ is the rate of weight loss in $mg/cm^2/sec$ and T is the absolute temperature. The rate of weight loss for a specimen of nominal composition 90 mol-% UC–10 mol-% ZrC was found to be 1.15×10^{-5} $mg/cm^2/sec$ at 2073°K. In contrast to results obtained for a similar specimen at 2300°K, the rate of weight loss remained constant with exposure time and no surface uranium depletion was observed. Studies of the compatibility of tungsten and uranium monocarbide to temperatures as high as 2000°C indicated that this combination of materials shows great promise as a nuclear-heated thermionic cathode. The kinetics of the interaction between mixtures of UC_2-UC and four refractory metals, niobium, tantalum, tungsten, and molybdenum, were further defined at 1800°C, and studies of these materials were extended to 1200°C. Electron-microprobe analyses of refractory-metal specimens which were placed in contact with UZrC(6.0 mol-% U–45.8 mol-% Zr–48.2 mol-% C) at 1800°C showed that uranium and zirconium penetrate deeply into niobium and tantalum in a period of 50 hr, but molybdenum and tungsten are less affected. Interdiffusion between UC and ZrC is being investigated to see if structures graded from a high-UC core to a high-ZrC surface would be stable for long periods of time at operating temperatures. Measurements of the electrical resistivities of uranium-carbon alloys in the composition range from UC to UC_2 were completed at temperatures to 2400°K. Work is progressing on the measurement of the electrical resistivities of mixed carbides of uranium and zirconium over the same temperature range. Procedures for thermal-conductivity measurement of the carbides were developed, and the necessary equipment was constructed and calibrated against a standard material (tantalum). (auth)

14351 (LNP-NR-140) SHIELDING PROBLEMS IN MANNED SPACE VEHICLES. Annual Report–1960. R. I. Allen, F. T. Bly, A. J. Dessler, C. C. Douglass, J. F. Perkins, H. C. Price, W. M. Schofield, and E. C. Smith—J. H. Tolan, ed. (Lockheed Georgia Co., Marietta, Ga.). Sept. 1961. Contract DA-01-009-506-ORD-832. 249p.

Results are presented that were obtained in the first phase of a study of the shielding requirements for manned space vehicles, as imposed by the natural radiations to be encountered in space flight and with consideration of the radiations from auxiliary nuclear power sources. The penetrating radiations known to exist in space are discussed and the reliabilities of various data are considered. Intensity, energy spectra, and spatial and time dependence of the various types of radiation are summarized in graphical and tabular form. Spatial distribution of trapped protons and electrons are presented in the form of contours of constant flux. Significance and general shielding implications of the more important penetrating radiations are treated. Computational methods for predicting dose rates due to high energy protons and electrons are formulated and results of calculations are presented. Proton dose rate calculations are based on the energy spectrum as determined by Freden and White; bremsstrahlung dose rates are calculated on the basis of the low-altitude electron spectrum measurements of Walt et al and of Holly and Johnson. It is found that attenuation of protons in shields of moderate thickness is governed largely by ionization energy losses while inelastic nuclear collisions result in attenuation of the primary flux of protons and in the production of secondary radiations, which become significant for very thick shields. Proton dose rates at the center of the proton belt range from 20 rad/hr behind a 2 gm/cm^2 shield to about 1 rad/hr behind a 100 gm/cm^2 carbon shield. Light elements are most effective for proton shields, as they offer combined advantages of large stopping power and relatively small production of low-energy secondary radiation. Carbon is a particularly effective element for proton shielding; its stopping power is exceeded only by those of hydrogen and helium. Hydrogeneous compounds may prove to be suitable, as the stopping power of hydrogen is more than twice that of any other element; and such compounds offer advantages of attenuation of both protons and secondary neutrons by nuclear collisions. Production of bremsstrahlung by electrons stopped in the vehicle exterior can be minimized by use of a thin layer of low-Z material. Bremsstrahlung dose rates in a lightly shielded vehicle reach values of several r/hr but are reduced to acceptable levels by 3 or 4 gm/cm^2 of lead or uranium. High energy protons accompanying solar flares present an imposing special case of shield design. Shields adequate for short transit flight through the belt of trapped protons offer meager protection against flare protons. Prediction of flare activity and temporary use of non-structural elements for shielding are discussed as remedial measures for protection during space flight. Uncertainties in the spectra of proton radiations and in the relative-biologic-effect of these radiations are discussed. A method of evaluating the biologic significance of an exposure by protons is suggested. (auth)

14352 (MND-P-2699(Vol.I)) UPPER ATMOSPHERE RE-ENTRY STUDY HIGH ALTITUDE BURNUP. VOLUME I. (Martin Co. Nuclear Div., Baltimore). [1961]. Contract AT(30-3)-217. 29p.

The principal objectives of the High Altitude Burnup Study were the evaluation of experimental methods for determining the fate of these radioactive fuels when burned up on re-entering the earth's atmosphere, and the recommendation of experimental programs to determine the size distribution of particulate matter resulting from burnup of the fuel and its subsequent dispersion, residence time and area of deposition. The experimental programs recommended are "particulate characteristics" program and "particulate fate" program. Three separate phases of testing are required: for the particulate characteristics experiments ablation rate testing; experimental determina-

tion of such physical constants as heat of vaporization for certain fuel forms; and particulate nucleation and agglomeration rate testing. The particulate fate experiments provide data permitting analytical prediction of residence time, dispersion, and area of deposition as functions of particulate characteristics, spatial origin, and season of injection. The specific experiments recommended are obtaining turbulence and wind data as functions of altitude, latitude, and season. (auth)

14353 (NASA-TN-D-1180) CERAMIC VACUUM ULTRAVIOLET ION CHAMBERS. Alfred K. Stober (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Nov. 22, 1961. 18p.

A new ceramic ion chamber for making vacuum ultraviolet radiation measurements in the laboratory and outside the earth's atmosphere was developed. This detector has excellent electrical insulating properties and a high work function. It is practically imperviable to the toxic effects of gases. An improved window-sealing technique aids in prolonging the life span of this ion chamber. A detailed description of the fabrication, gas filling, and sealing techniques is given. The ion chamber calibration procedure is briefly outlined. The usefulness of the chamber in the 1050 to 1500A spectral region is noteworthy because the detector can be made to operate over a relatively narrow bandpass with a sharp cutoff (rejection of photons) on either side of the selected wavelength region. Other useful properties include the high quantum yield, the extremely low noise level, and the capability to serve as a gas-gain multiplier. (auth)

14354 (NASA-TN-D-1188) GOVERNMENT-INDUSTRY CONFERENCE ON MERCURY CONDENSING, APRIL 18, 1961, PASADENA, CALIFORNIA. (National Aeronautics and Space Administration, Washington, D. C.). Feb. 1962. 163p.

Included are a collection of presentations on current developments by government and industrial organizations actively engaged in research and development on condensing components for Rankine cycle space power systems using mercury as the working fluid. A summary of a general discussion period treating specific topics in mercury condensing is also included. (auth)

14355 (NP-11415) SPACE ELECTRIC POWER SYSTEMS STUDY. First Quarterly Progress Report, November 8, 1961–February 8, 1962. F. X. Dobler, C. L. Doughman, R. C. Fear, et al. (Westinghouse Electric Corp., Lima, Ohio). Contract NAS5-1234. 318p.

Activities in a program to develop parametric data for generation, control, conversion, and transmission of electric power for space vehicles are described. Information is included on methods of electrical control, 1-Mw generator design for the scoped voltage, temperature, and rotational speed range, generator materials and frequency, and other basic generator parameters. Data are included on electrical control and conversion subsystems, and results obtained in an evaluation of transformer rectifier circuits for configuration optimization are presented. Results of an investigation of coolant characteristics for electrical control and conversion component heat removal are also given followed by developments in calculation methods and data for evaluation of power transmission. The major problems uncovered during the report period are the unavailability of high-temperature magnetic materials for the generator and suitable high-temperature components for use in the electrical control and conversion subsystems. (J.R.D.)

14356 (NP-11567) PUBLICATIONS OF THE JET PROPULSION LABORATORY, JANUARY 1938 THROUGH JUNE 1960. Bibliography No. 39-1. D. K. Walsh and R. J. Sippel (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Dec. 29, 1961. Contract NASw-6. 341p.

The bibliography is comprised of an author index, numerical index, and a subject index in addition to other sections which contain listings of summary publications and astronautics information. An estimated 2500 references are included. (J.R.D.)

14357 (NP-11586) ASTRONAUTICS INFORMATION. OPEN LITERATURE SURVEY, VOL. V, NO. 2, ENTRIES 50,206–50,417. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Feb. 1962. Contract NAS 7-100. 39p.

A survey of open literature in the area of astronautics is presented for January 1962. The references are restricted in general to space flight data and techniques. (J.R.D.)

14358 (PWA-2043) DETERMINATION OF THE EMISSIVITY OF MATERIALS. Progress Report, October 1 through December 31, 1961. William H. Askwyth (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Contract NASw-104. 82p.

Work in support of NASA space power systems is reported in which an aluminum phosphate-bonded coating completed 3800 hours of endurance on a SNAP-8 finned-tube radiator segment. Plasma flame-sprayed coatings of titania on SNAP-8 and Sunflower I sections completed 1400 hours. A fourth rig containing a SNAP-8 section with an aluminum phosphate-bonded coating accumulated 120 hours. Total emittance was measured on coatings of zirconium silicate on stainless steel strip, Rokide C on stainless steel tube, titania base powder on aluminum strip and on stainless steel strip, aluminum phosphate bonded with boron and silica on aluminum strip, aluminum phosphate bonded with silicon carbide and silica on aluminum strip, ceric oxide on stainless steel strip, acetylene black in xylol on aluminum strip, titania on aluminum strip, strontium titanate on stainless steel strip, oxidized stainless steel, and titania-alumina on stainless steel. Endurance testing was conducted on the Rokide C, oxidized stainless steel, and titania-alumina on stainless steel. (auth)

14359 (TID-14945) PLASMA ACCELERATION EXPERIMENTS. Annual Report. (Stevens Inst. of Tech., Hoboken, N. J.). Jan. 1962. Contract AT(30-1)-1921. 20p. (SIT P57(2/62)).

The construction of two plasma accelerator systems is reported. A 1000-joule, 60-ev, low-inductance capacitor with a 15 in.-long copper gun is used in one design. Provisions are made in this system for gas injection, plasma injection from a ring of bottom guns, or both. Another system is described which has a maximum capacitor bank energy of 2400 joules. The gas is injected by a mechanically pulsed valve. Research and development is also reported on the axial acceleration of plasma by axial magnetic fields. (J.R.D.)

14360 (WADD-TR-60-849) INVESTIGATION OF SOLAR CONCENTRATING PHOTOVOLTAIC POWER GENERATORS. Donald H. McClelland (Electro-Optical Systems, Inc., Pasadena, Calif.). Oct. 15, 1960. Contract AF33(616)-7346. 348p. (AD-264989)

The use of concentration with photovoltaic power generators is studied. A preliminary investigation of all factors relating to the use of concentration in this context is carried out. The preliminary design is shown for a 50-watt scale model. (auth)

14361 AN ELECTROSTATIC PROPULSION SYSTEM WITH A HIGH-FREQUENCY ION SOURCE. Horst Loeb (Universität, Giessen, Ger.). Astronaut. Acta, 8: 49-62 (1962). (In German)

A thrust generator, consisting of a high-frequency ion source and an electrostatic accelerator, is described and tested. It weighs 150 g, gives mercury ions of 7 ma current and specific impulses between 10000 and 20000 sec and generates thrusts up to 0.3 lb. The over-all efficiency of conversion from electric power to jet power ranges from 50 to 70%. A propulsion system using this thrust generator reaches with a payload of 500 g in a year a diving output up to 30 km/sec. By combining many thrust generators stronger propulsion systems can be constructed. (auth)

14362 PLASMA PROPULSION. PART I. Sterge T. Demetriades (Northrop Space Labs., Hawthorne, Calif.). Astronautics, 7: No. 3, 21, 40; 42(Mar. 1962).

Optimum exhaust velocity versus design velocity increment for a space vehicle stage with an electrical (MHD) propulsion system is reviewed along with the critical factors for a given mission. An illustration is given for the optimum exhaust velocity required for low-thrust escape from orbit around the earth. (N.W.R.)

14363 ELECTRO-PROPULSION SYSTEM APPLICATIONS. John W. Stearns (NASA Jet Propulsion Lab., Pasadena, Calif.). Astronautics, 7: No. 3, 22-3; 74; 76-80 (Mar. 1962).

The propulsion necessary to take a spacecraft from an initial earth orbit and perform a required planetary mission is discussed. Particular consideration is given to powerplant takeoffs with respect to weight limitations and the most suitable type of propulsion system to use. From the results given in comparing nuclear rocket and nuclear-electric propulsion systems for Jupiter missions, the electric system is superior in both payload and flight time. Furthermore, for many very difficult missions, electric propulsion seems to provide the only means of reaching the spacecraft destination. Powerplant requirements are given for missions to Mars and Jupiter, and performance estimates are made for other planetary missions. (N.W.R.)

14364 NEW POWER SOURCES AND ENERGY CONVERTERS. David Linden (Army Signal Research and Development Lab., Ft. Monmouth, N. J.). Electronics, 35: No. 14, 35-42(Apr. 6, 1962).

Progress in the development of portable electrical power sources is reported. A comparison of the power output of the different power systems as a function of service time (projected to the 1965-70 period when the newer systems should be available) is given. The curves show typical performance, but a wide variation in performance is to be expected, depending on the power level, the specific electrical requirements, shielding, environmental requirements, space or ground applications, and other design factors. The chemical systems show up well for the short duration requirement or, as a secondary battery, for energy storage or for handling peak load requirements. The fuel cell and chemical-thermal systems will fulfill requirements in the medium life range. The solar and nuclear reactor systems are good for long periods of operation. The photovoltaic devices will be important at the lower power levels up to 1 kw, the solar-thermal systems from 100 w to 10 kw, and the reactor systems for the higher power levels. (N.W.R.)

14365 SPACE POWERPLANT SHIELD DESIGN OPTIMIZATION. F. L. Bouquet, Jr. (Lockheed Aircraft Corp., Burbank, Calif.). IRE Trans. on Nuclear Sci. NS-9, No. 2, 83-4(Apr. 1962).

Equations for two- and three-layer shields for space powerplants are presented, and the limitations of the equations are indicated. The relation between the external radii of the shields is determined as a function of the attenuation required, the densities of the materials, the radius of the source, and the effective absorption coefficients. Single and multiple layer shield weights may be calculated and compared. Although the use with gamma radiation is shown, the equations can be extended to other types of nuclear radiation, and to other geometries. (P.C.H.)

14366 THE HAZARD OF CORPUSCULAR SOLAR RADIATION TO MANNED SPACEFLIGHT. C. J. Waddington (Univ. of Bristol, Eng.). J. Brit. Interplanet. Soc., 18: 277-80(Jan.-Feb. 1962).

The presently available data on the "storms" of solar particles are used to compute the radiation dose that would be received by astronauts shielded by different thicknesses of material. It is shown that at least some of these storms represent a severe hazard to successful manned spaceflights. (auth)

WASTE DISPOSAL AND PROCESSING

Refer also to abstract 13025.

14367 (AECL-1427) DECONTAMINATION PRINCIPLES AND TECHNIQUES. J. M. White (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1961. 33p.

A description of various techniques used in decontamination at Chalk River is given. Several machines used in this work are shown. Decontamination standards are given for equipment, clothing, and personnel. Design parameters for a building in which decontamination may be conducted are given, along with illustrations of the facilities at Chalk River. Costs of decontamination are outlined. (auth)

14368 (AEC-tr-5045) A STUDY OF ALUMINUM–PHOSPHATE FLOCCULATION AS A PROCESSING METHOD OF WEAKLY RADIOACTIVE WASTES. K. F. Eschle. Translated for Oak Ridge National Lab., Tenn. from Neue Tech., 3: 151-61(Mar. 1961). 32p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 20475.

14369 RADIOACTIVE WASTE AND ITS TREATMENT. Dieter Schoenberg (Institut für Medizin und Biologie, Deutsche Akademie der Wissenschaften, Berlin and Institut für Angewandte Isotopenforschung, Berlin-Buch). Chem. Tech. (Leipzig), 14: 28-32(Jan. 1962). (In German)

Problems in the treatment of radioactive waste are discussed. The maximum permissible concentration was established, and its necessity explained. The detection of radionuclides in the waste is mentioned. The processes for the treatment of radioactive waste water are described, and some ideas for the construction of waste plants are given. Several selected literature citations should make possible the study of individual problems. (tr-auth)

14370 THE SUITABILITY OF PEAT FOR THE PURIFICATION OF RADIOACTIVE WASTES. I. PEAT AS CATION EXCHANGER. (Continued from No. 7, Isotopentechnik, 1: 219-21(Sept. 1961)). R. Winkler and J. Gens (Zentralinstitut für Kernphysik, Rosendorf, Ger.). Isotopentechnik, 1: 246-7(Nov. 1961). (In German)

Studies of the exchange of Cs^{+}, Sr^{2+}, and Ce^{3+} on peat under static and dynamic conditions were continued. In this section, the consequences of the experimental results are discussed. (J.S.R.)

14371 DISTRIBUTION OF Co^{60} AND OF SOME RADIOISOTOPE FISSION PRODUCTS AMONG THE COMPONENTS OF EXPERIMENTAL RESERVOIRS. I. O. Bogatyrev (Inst. of Biophysics, Academy of Sciences, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Biol., No. 1, 122-6(Jan.-Feb. 1962). (In Russian)

Observations of the distribution of Co^{60}, Cs^{137}, Ru^{106}, Sr^{90}, and mixed β- and γ-emitting fission fragment in open reservoirs showed a rather strong retention of Sr^{90} by the water with considerably lesser retention by silt, an extremely high concentration of Co^{60} in the marine plants (elodia and urut), and a rather high absorption of Cs^{137} by sand. The distribution of Ru^{106} was close to that of Co^{60}, and the mixed fission fragment distribution was similar to that of Sr^{90}. The data indicate the feasibility of utilizing reservoirs for storing liquid wastes containing radioelements (except Sr^{90}). (R.V.J.)

14372 DECONTAMINATION FACTOR OF A RADIOCHEMICAL WASTE EVAPORATOR SYSTEM. Tetsuo Mamuro, Takashi Matsumura, Toshio Ishiyama, Kazuko Yoshikawa, and Takashi Karino (Radiation Center of Osaka Prefecture). Nippon Genshiryoku Gakkaishi, 4: 100-5 (Feb. 1962). (In Japanese)

A study was made to determine the decontamination efficiency of a radiochemical waste evaporator system, which consisted of evaporator, cyclone, mist-separator and condenser. The system was designed to handle the liquid radioactive waste, which ranged in activity from 10^{-4} to 10^{-2} μc/ml, at the rate of 200 l/hr and to get a volume reduction ratio of 100 ~ 200. The evaporator is single effect and vertical shell-and-tube type, and is operated for non-foaming liquid by fixing the liquid level above the upper tube sheet of the calandria. For foaming liquid, however, the evaporator is operated by lowering the liquid level below the middle of the calandria. In the latter case, the upper part of the tubes above the liquid surface serves as a foam breaker. The decontamination factors of the evaporator, cyclone, and mist-separator and the over-all decontamination factor were measured for the boil-up rates varying from 50 to 300 l/hr. Lithium chloride and strontium nitrate solutions were used as test liquid. The decontamination characteristic of the evaporator is different for the two test liquids and depends on the liquid level. The over-all decontamination factor was measured to be 10^{6} ~ 10^{8} and it was revealed that the required decontamination efficiency was achieved. Discussion is given on the mechanism of the generation of liquid entrainment. (auth)

14373 REMOVAL OF RADIOACTIVE IONS FROM WATERS. Wyatt B. Silker (to U. S. Atomic Energy Commission). U. S. Patent 3,029,200. Apr. 10, 1962.

A process for removing neutron-reaction products, such as phosphorus, arsenic, manganese, copper, zinc, lanthanides, and actinides, from aqueous solutions by sorption on particles of aluminum metal is described. (AEC)

CORPORATE AUTHOR INDEX

This index contains entries for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

Each entry under a corporate author is a shortened version of the title of the publication, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt." This change permits a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

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Æ	becomes	ae
ö		oe
ø		oe
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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries. A more complete description of the patterns and style of indexing used is included in the introductions to the subject index cumulations that are issued quarterly.

As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number in that volume. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Published literature (journal article or book) is identifiable by the absence of a report number.

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5111	16-13245	p. 526-34 of "International Developments in Heat Transfer, Pt. III." New York, The American Society of Mechanical Engineers, 1961
5303	16-13068	Nuclear Sci. and Eng. 12: 39-45(1962)
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EURAEC–		
30	16-13531	Dep.(mc); $9.60(fs), $3.80(mf) OTS
44	16-13206	Dep.(mc); $8.10(fs), $2.84(mf) OTS
F-A–	**(Misc.)**	
2150-2	16-14310	See NYO-9614
2476*	16-13515	See NP-11591
FD–	**(Canadian)**	

Report No.	Abstract No.	Availability
74	16-14230	Dep.(mc)
75	16-13544	Dep.(mc)
77	16-13545	Dep.(mc)
FTD-TT-	**(Non-AEC)**	
61-124	16-14242	OTS
61-169	16-13187	OTS
61-276	16-13711	OTS
61-333	16-13188	OTS
61-442	16-13308	OTS
61-448	16-13873	OTS
62-116	16-14145	OTS
62-183	16-12885	OTS
FXM-	**(Misc.)**	
1071	16-14231	Dep.(mc); $2.60(fs), $0.95(mf) OTS
3323	16-13391	Dep.(mc); $4.60(fs), $1.61(mf) OTS
GA-	**(Misc.)**	
1787	16-13246	p. 535-42 of "International Developments in Heat Transfer. Pt. III." New York, The American Society of Mechanical Engineers, 1961
1882	16-13072	Nuclear Sci. and Eng. 12: 106-10(1962)
2211	16-12948	Dep.; $0.75(OTS)
2747	16-14285	Dep.; $2.75(OTS)
3007*	16-14350	
GEAP-	**(Misc.)**	
3785	16-14286	Dep.; $4.00(OTS)
GEMP-		
71	16-14232	Dep.; $1.00(OTS)
HASL-		
119	16-13288	Dep.; $0.75(OTS)
HE-	**(Misc.)**	
150-182*	16-13692	
HW-		
60886	16-13513	Dep.(mc); $1.10(fs), $0.80(mf) OTS
62347	16-13546	Dep.; $1.25(OTS)
65939	16-14287	Dep.(mc); $2.60(fs), $0.92(mf) OTS
67364	16-13001	Dep.(mc); $2.60(fs), $0.83(mf) OTS
68607	16-13324	IRE Trans. on Nuclear Sci. NS-9, No. 2: 85-90(1962)
69832	16-13576	Dep.(mc); $0.50(OTS)
70310	16-13857	Dep.; $2.00(OTS)
70536	16-13125	Dep.; $0.75
71388	16-13289	Dep.; $0.50(OTS)
72114	16-13081	Dep.; $1.60(fs), $0.80(mf) OTS
HW-SA-		
2216	16-12966	Anal. Chem. 34: 522-5(1962)
2254	16-13106	J. Phys. Chem. 66: 463-8(1962)
HW-tr-		
33	16-13021	Dep.(mc); $4.60(fs), $1.52(mf) JCL
IA-	**(Non-AEC)**	
685	16-12801	Dep.(mc)
IDO-		
12018	16-13398	Am. Ind. Hyg. Assoc. J. 23: 83-7(1962)
14573	16-13126	Dep.; $0.50(OTS)
16741	16-13290	Dep.; $0.50(OTS)
16745	16-14339	Dep.; $2.50(OTS)
IFA-M-	**(Rumanian)**	
24	16-14105	
25	16-14106	
26	16-13291	Dep.(mc)
IS-		
312	16-13613	J. Less-Common Metals 4: 92-7(1962)
328	16-13633	Trans. Met. Soc. AIME, 224: 354-7(1962)
364	16-13797	Phys. Rev. 125: 1568-9(1962)
ITR-	**(Misc.)**	
1101*	16-12813	See WT-1101
1419*	16-12817	See WT-1419
1420*	16-12818	See WT-1420
1423*	16-12819	See WT-1423
JINR-	**(Russian)**	
D-844	16-13861	Dep.(mc)
D-900	16-13862	Dep.(mc)
P-777	16-13874	For translation see UCRL-Trans-798
P-830	16-13945	Dep.(mc)
P-843	16-14208	Dep.(mc)
P-845	16-13946	Dep.(mc)
P-863	16-13863	Dep.(mc)
P-864	16-13693	Dep.(mc)
P-866	16-13947	Dep.(mc)
P-875	16-13948	Dep.(mc)
P-877	16-13949	Dep.(mc)
P-887	16-13950	Dep.(mc)
P-888	16-13864	Dep.(mc)
P-898	16-13951	Dep.(mc)
JPRS-	**(Non-AEC)**	
12487	16-13309	OTS
12712	16-12937	OTS
12754	16-13713	OTS
JÜL-	**(German)**	
25-PP	16-13501	Dep.(mc)
28-KP	16-13952	Dep.(mc)
30-KP	16-13953	Dep.(mc)
K-		
1463	16-12949	Dep.; $0.50(OTS)
KR-	**(Norwegian)**	
13	16-14288	Dep.(mc)
16	16-14233	Dep.(mc)
LAMS-		
2675	16-13577	Dep.; $1.50(OTS)
LAS-TR-		
161-35	16-13300	See TID-14178
LNP-NR-	**(Non-AEC)**	
140	16-14351	
MATT-		
63	16-14137	Dep.; $2.50(OTS)
94	16-14178	Phys. Fluids 5: 363-4(1962)
96	16-14162	Phys. Fluids 5: 192-5(1962)
97	16-14164	Phys. Fluids 5: 210-12(1962)
111	16-13802	Phys. Rev. Letters 8: 234-7(1962)
MF-	**(Misc.)**	
26	16-13502	See NYO-9601
27	16-13702	See NYO-9602
MH-	**(Non-AEC)**	
11	16-13677	See AFCRL-268
ML-	**(Misc.)**	
877*	16-13694	OTS
MLM-		
1118	16-13082	Dep.; $1.60(fs), $0.80(mf) OTS
MMPP-	**(Misc.)**	
167-3	16-13086	See TID-15262
178-1	16-13086	See TID-15262
MND-C-		
2487	16-14289	Dep.; $4.00(OTS)
MND-E-	**(Misc.)**	
2727*	16-13532	
MND-M-	**(Misc.)**	
1858	16-14304	Dep.; $4.50(OTS)
MND-P-		
2699(Vol.I)	16-14352	Dep.; $0.50(OTS)
2720	16-13695	Dep.; $2.50(OTS)
MR-N-	**(Non-AEC)**	
283	16-14203	See NARF-62-1T
287	16-14202	See NARF-61-41T
NAA-SR-		
6226	16-13547	Dep.; $0.50(OTS)
6769	16-13207	Dep.; $1.00(OTS)
6789	16-13578	Dep.; $0.50(OTS)
6976	16-13127	Dep.; $0.50(OTS)
NAA-SR-Memo-		
2188	16-14305	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2919-1	16-14306	Dep.(mc); $1.60(fs), $0.80(mf) OTS
4093	16-14307	Dep.(mc); $8.60(fs), $2.96(mf) OTS

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4824	16-14308	Dep.(mc); $10.50(fs), $4.28(mf) OTS
6283	16-13292	Dep.(mc); $2.60(fs), $0.83(mf) OTS
6505	16-13858	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6670	16-13696	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6760	16-13954	Dep.(mc); $7.60(fs), $2.36(mf) OTS
6781	16-14234	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6819	16-12950	Dep.(mc); $2.60(fs), $0.89(mf) OTS
6866	16-13928	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6872	16-13392	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6942	16-13208	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6946	16-13209	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6954	16-14309	Dep.(mc); $4.60(fs), $1.67(mf) OTS
7079	16-13514	Dep.(mc); $4.60(fs), $1.55(mf) OTS
NAMC-ASL–	**(Non-AEC)**	
1050(Pt.I)	16-13293	
NARF–	**(Non-AEC)**	
61-41T	16-14202	
62-1T	16-14203	
NASA-TN–	**(Misc.)**	
D-1180*	16-14353	$0.50(OTS)
D-1188*	16-14354	$3.00(OTS)
NASA-TR–	**(Non-AEC)**	
R-132	16-13210	
NEI–	**(Canadian)**	
13(Rev.)	16-14235	Dep.; $1.00(AECL)
NEVIS–	**(Misc.)**	
95	16-13342	Rev. Sci. Instr. 32: 1222-3(1961)
101*	16-13865	
NIRL-R–	**(British)**	
9	16-13294	Dep.(mc); $0.49(BIS)
10	16-13176	Dep.(mc); $0.70(BIS)
13	16-14107	Dep.(mc); $0.56(BIS)
17	16-14108	Dep.(mc); $0.63(BIS)
NLCO–		
836	16-13002	Dep.; $1.50(OTS)
NMI–	**(Misc.)**	
7212	16-13579	Dep.(mc); $2.60(fs), $1.04(mf) OTS
7216	16-13548	Dep.(mc); $3.60(fs), $1.28(mf) OTS
NP–	**(AEC File No. for Non-AEC Reports)**	
11299	16-13003	
11338	16-13697	
11363	16-13698	Dep.(mc)
11369	16-14138	
11375	16-13955	Dep.(mc)
11381	16-13411	Dep.(mc)
11401	16-13956	
11403	16-13957	
11411	16-13004	
11413	16-13177	
11415	16-14355	
11416	16-13412	
11418	16-13295	
11421	16-13866	Dep.(mc)
11422	16-13958	Dep.(mc)
11423	16-12845	
11425	16-12846	
11426	16-13699	
11429	16-13700	
11551	16-13580	
11554	16-14109	
11555	16-13549	
11558	16-12802	
11566	16-13959	
11567	16-14356	
11570	16-13641	
11571	16-13960	
11573	16-14139	
11582	16-13178	
11583	16-14140	
11585	16-12951	
11586	16-14357	

Report No.	Abstract No.	Availability
11588	16-13701	Dep.
11590	16-13550	
11591	16-13515	
11594	16-13961	
11598	16-13005	OTS
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
841	16-13310	$2.60(fs), $1.07(mf) JCL
850	16-13022	Dep.(mc); $1.10(fs), $0.80(mf) JCL
860	16-12886	Dep.(mc); $3.60(fs), $1.31(mf) JCL
868	16-13311	Dep.(mc); $6.60(fs), $2.27(mf) JCL
869	16-13718	Dep.(mc); $3.60(fs), $1.13(mf) JCL or OTS
870	16-13493	Dep.(mc); $1.60(fs), $0.80(mf) JCL
NRC–	**(Canadian)**	
6683	16-13031	Can. J. Phys. 40: 322-47(1962)
6700	16-13032	Can. J. Phys. 40: 358-66(1962)
NUMEC-P–		
39	16-14236	Dep.(mc); $1.10(fs), $0.80(mf) OTS
NYO–		
9420	16-13083	Dep.; $1.00(OTS)
9601	16-13502	Dep.(mc); $5.60(fs), $1.82(mf) OTS
9602	16-13702	Dep.(mc); $3.60(fs), $1.27(mf) OTS
9614	16-14310	Dep.(mc); $9.10(fs), $3.38(mf) OTS
9830	16-13084	Dep.(mc); $3.60(fs), $1.16(mf) OTS
10033	16-13867	Dep.(mc); $2.60(fs), $0.92(mf) OTS
10037	16-13868	$2.60(fs), $0.92(mf) OTS
10125	16-13869	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10127	16-13870	$1.60(fs), $0.80(mf) OTS
10183	16-13128	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ORA–	**(Misc.)**	
3710-2-P	16-13086	See TID-15262
ORNL–		
2811	16-13179	Dep.; $0.75(OTS)
2867(Rev.)	16-14311	Dep.; $2.50(OTS)
3238	16-14312	Dep.; $2.50(OTS)
ORNL-TM–		
79	16-13180	Dep.(mc); $5.60(fs), $1.76(mf) OTS
129	16-13370	Dep.(mc); $1.60(fs), $0.80(mf) OTS
132	16-13642	Dep.(mc); $2.60(fs), $1.07(mf) OTS
134	16-14313	Dep.(mc); $19.75(fs), $9.27(mf) OTS
168	16-13929	Dep.(mc); $3.60(fs), $1.34(mf) OTS
172	16-14237	Dep.(mc); $3.60(fs), $1.28(mf) OTS
ORO–		
527	16-13551	Dep.(mc); $2.60(fs), $0.83(mf) OTS
OSB–	**(Non-AEC)**	
15	16-14314	OTS
PAN–	**(Polish)**	
154	16-13701	See NP-11588
248/XIII	16-13296	Dep.(mc)
253/VI	16-13962	Dep.(mc)
254/I-B	16-13581	Dep.(mc)
255/VI	16-13963	Dep.(mc)
256/VIII	16-12952	Dep.(mc)
258/VII	16-13964	Dep.(mc)
265/XIII	16-13297	Dep.
267/IV	16-13129	Dep.(mc)
268/X	16-12953	Dep.
271/VIII	16-13130	Dep.
272/IV	16-13118	Dep.
273/I-B	16-13703	Dep.
278/VI	16-13844	Dep.
280/IV	16-13131	Dep.
281/VII	16-13965	Dep.
286/VI	16-13966	Dep.
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
889,319	16-13193	
889,709	16-13194	
891,727	16-14192	
891,799	16-14260	
891,804	16-14334	
891,806	16-13195	
891,852	16-14335	

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891,865	16-14261	
891,944	16-13117	
891,983	16-14127	
891,984	16-14128	
891,985	16-14129	
891,986	16-14130	
891,988	16-13365	
892,087	16-13500	
892,122	16-13196	
892,240	16-14262	
892,241	16-14263	
892,280	16-13526	
892,290	16-14264	
892,341	16-14265	
892,559	16-14266	
892,603	16-13197	
892,764	16-13163	
892,805	16-13366	
PATENTS	**(Italian)**	
353882	16-13593	
357876	16-13593	See CEA-tr-X-259
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
3,028,256	16-13527	
3,028,329	16-14267	
3,028,517	16-14193	
3,029,130	16-13164	
3,029,142	16-13165	
3,029,184	16-12860	
3,029,197	16-14268	
3,029,198	16-14269	
3,029,199	16-14194	
3,029,200	16-14373	
3,029,796	16-13198	
3,029,842	16-13199	
3,030,175	16-13122	
3,030,176	16-13166	
3,030,294	16-14270	
3,030,510	16-13367	
3,030,543	16-14195	
3,030,547	16-13368	
3,031,174	16-13200	
3,031,261	16-13167	
3,031,294	16-13528	
3,031,304	16-13838	
3,031,342	16-13529	
3,031,385	16-13079	
3,031,389	16-13561	
3,031,394	16-12936	
3,031,396	16-14196	
3,031,397	16-14271	
3,031,398	16-14197	
3,031,608	16-13369	
PG-Report–	**(British)**	
267	16-12954	Dep.; $0.35(BIS)
269	16-12955	Dep.; $0.21(BIS)
271	16-12956	Dep.; $0.21(BIS)
272	16-12957	Dep.; $0.21(BIS)
281	16-12958	Dep.; $0.21(BIS)
288	16-12878	Dep.; $0.42(BIS)
PLR–	**(Non-AEC)**	
91	16-14141	
PNE–		
109P	16-12803	Dep.; $1.25(OTS)
110P	16-12804	Dep.; $2.00(OTS)
PPAD–		
425-E	16-13322	IRE Trans. on Nuclear Sci. NS-9, No. 2: 19-25(1962)
428-E	16-14115	IRE Trans. on Nuclear Sci. NS-9, No. 2: 26-31(1962)
432C	16-13503	Dep.(mc); $1.60(fs), $0.80(mf) OTS
433C	16-13298	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PPL-TR–	**(Non-AEC)**	
61-18	16-14142	
PRDC-TR–		
52	16-14315	Dep.(mc); $2.60(fs), $0.86(mf) OTS
PREDC–		
3079	16-14316	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PUC–		
1961-40	16-13840	Revs. Modern Phys. 34: 110-22(1962)
PWA–	**(Non-AEC)**	
2043	16-14358	
PWAC–	**(Misc.)**	
111	16-13181	Dep.(mc); $1.60(fs), $0.80(mf) OTS
Q-A–		
2392-3-1	16-13182	See TID-13998
R–	**(Misc.)**	
61APE-95*	16-14336	See APED-3855
61SD010*	16-13582	OTS
RAD-SR–	**(Non-AEC)**	
62-11	16-14143	
RDB(W)–	**(British)**	
TN-63	16-13583	Dep.(mc)
RFR–	**(Swedish)**	
39	16-14238	Dep.(mc)
RISO–	**(Danish)**	
34	16-14239	Dep.(mc); Jul. Gjellerup, 87 Solvgade, Copenhagen K, Denmark
RM–	**(Misc.)**	
102*	16-13564	See AFOSR-2139
RR–	**(Misc.)**	
22*	16-13549	See NP-11555
SAER–	**(French)**	
1344/906	16-14337	See CEA-2005
SB–	**(Non-AEC)**	
444	16-13364	
62-4	16-13005	See NP-11598
SCL-T–		
407	16-13023	Dep.(mc); $1.60(fs), $0.80(mf) JCL
410	16-13087	Dep.(mc); $1.60(fs), $0.80(mf) JCL
411	16-13024	Dep.(mc); $1.10(fs), $0.80(mf) JCL
SCTM–		
137-61(24)	16-13299	Dep.(mc); $2.60(fs), $0.83(mf) OTS
SIT-P–	**(Misc.)**	
57	16-14359	See TID-14945
SI-Publ.–	**(Norwegian)**	
337	16-13568	See ARL-239(Pt.II)
SRE-PR–	**(French)**	
7	16-13080	See CEA-2072
SRO–		
44	16-13006	Dep.; $1.25(OTS)
STI-PUB–	**(International Atomic Agency)**	
4(p.97-102)	16-14345	Also available as AECL-1330
9	16-14343	$3.50(IAEA)
9(p.35-40)	16-14344	Also available as AECL-1331
9(p.251-6)	16-14346	Also issued as AECL-1332
22(p.253-4)	16-14347	Also issued as AECL-1334
22(p.281-6)	16-14348	Also issued as AECL-1335
9(p.301-6)	16-14349	Also available as AECL-1333
TID–		
3569	16-12881	Dep.; $1.75(OTS)
6613(Suppl.2)	16-13413	Dep.; $2.50(OTS)
13446	16-13704	Dep.(mc); $6.60(fs), $2.03(mf) OTS
13910	16-12959	Dep.(mc); $5.60(fs), $1.82(mf) OTS
13998	16-13182	Dep.(mc); $3.60(fs), $1.22(mf) OTS
14178	16-13300	Dep.; $2.50(OTS)
14632	16-13211	Dep.(mc); $10.10(fs), $3.89(mf) OTS
14667	16-13643	Dep.(mc); $6.60(fs), $2.06(mf) OTS
14744	16-13007	Dep.(mc); $3.60(fs), $1.25(mf) OTS
14808	16-13584	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14821	16-13930	Dep.(mc); $7.60(fs), $2.42(mf) OTS
14882	16-12882	Dep.(mc); $2.60(fs), $1.01(mf) OTS
14943	16-13705	Dep.(mc); $1.60(fs), $0.80(mf) OTS

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14945	16-14359	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14950	16-13585	Dep.(mc); $6.60(fs), $2.18(mf) OTS
14973	16-14204	Dep.(mc); $6.60(fs), $2.18(mf) OTS
14981	16-13586	Dep.(mc); $2.60(fs), $0.95(mf) OTS
15001	16-12883	Dep.(mc); $2.60(fs), $0.86(mf) OTS
15006	16-13008	Dep.(mc); $2.60(fs), $0.89(mf) OTS
15043	16-13644	Dep.(mc); $11.50(fs), $4.76(mf) OTS
15057	16-14317	Dep.(mc); $6.60(fs), $2.09(mf) OTS
15061	16-12861	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15063	16-14318	Dep.(mc); $7.60(fs), $2.60(mf) OTS
15138	16-13516	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15139	16-13517	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15140	16-13183	Dep.(mc); $21.00(fs), $9.66(mf) OTS
15149	16-13009	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15150	16-13010	Dep.(mc); $4.60(fs), $1.46(mf) OTS
15154	16-14110	Dep.(mc); $8.10(fs), $2.84(mf) OTS
15194	16-14240	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15197	16-13011	Dep.(mc); $8.60(fs), $2.96(mf) OTS
15198	16-13706	Dep.(mc); $2.60(fs), $0.92(mf) OTS
15205	16-12944	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15218	16-13587	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15226	16-13301	Dep.(mc); $6.60(fs), $2.27(mf) OTS
15227	16-13012	Dep.(mc); $8.60(fs), $3.14(mf) OTS
15229	16-13016	Dep.(mc); $2.60(fs), $0.98(mf) OTS
15230	16-13645	Dep.(mc); $3.60(fs), $1.34(mf) OTS
15251	16-13085	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15262	16-13086	Dep.(mc); $4.60(fs), $1.46(mf) OTS
15279	16-13302	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15299	16-12862	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15339	16-13518	Dep.(mc); $2.60(fs), $1.04(mf) OTS
TIM–		
287	16-13588	Dep.(mc); $3.60(fs), $1.40(mf) OTS
406	16-12960	Dep.(mc); $1.60(fs), $0.80(mf) OTS
482	16-14241	Dep.(mc); $2.60(fs), $0.89(mf) OTS
483	16-13212	Dep.(mc); $1.60(fs), $0.80(mf) OTS
483(Suppl.1)	16-13213	Dep.(mc); $1.60(fs), $0.80(mf) OTS
499	16-13184	Dep.(mc); $1.60(fs), $0.80(mf) OTS
506	16-13646	Dep.(mc); $1.60(fs), $0.80(mf) OTS
TN–	**(Non-AEC)**	
383	16-13388	See AD-264022
TT–	**(Canadian)**	
1003	16-12962	Dep.(mc); NRC or JCL
UCRL–		
6280	16-13048	J. Inorg. & Nuclear Chem. 22: 231-9 (1961)
6469	16-14150	IRE Trans. on Nuclear Sci. NS-9, No. 2: 57-67(1962)
6486-T	16-14179	Phys. Rev. 125: 1131-40(1962)
6515	16-14007	Phys. Rev. 125: 1339-49(1962)
6604	16-13931	Dep.; $2.75(OTS)
6646-T	16-13360	Rev. Sci. Instr. 33: 380-2(1962)
6699	16-14118	IRE Trans. on Nuclear Sci. NS-9, No. 2: 53-6(1962)
6721	16-13932	Dep.; $0.50(OTS)
6740	16-13303	Dep.; $1.00(OTS)
9390(Rev.)	16-14003	Phys. Rev. 125: 1310-18(1962)
9682	16-14176	Phys. Fluids 5: 348-60(1962)
9751	16-14008	Phys. Rev. 125: 1350-7(1962)
9762	16-13895	Phys. Rev. 125: 1696-1702(1962)
9841	16-13871	Dep.; $2.00(OTS)
9873	16-13017	Dep.; $2.00(OTS)
9944	16-13018	Dep.; $1.50(OTS)
9968	16-13323	IRE Trans. on Nuclear Sci. NS-9, No. 2: 68-73(1962)
9999	16-13872	Dep.; $1.50(OTS)
10009	16-13304	Dep.; $0.75(OTS)
UCRL-Trans–		
764(L)	16-13594	Dep.(mc); $1.60(fs), $0.80(mf) JCL
780(L)	16-13595	Dep.(mc); $1.10(fs), $0.80(mf) JCL
790(L)	16-12820	Dep.(mc); $4.60(fs), $1.52(mf) JCL
798	16-13874	Dep.(mc); $4.60(fs), $1.61(mf) JCL or OTS
UMRI–	**(Misc.)**	
2765-10-F	16-13585	See TID-14950
USCEC–	**(Non-AEC)**	
82-202	16-14144	
USNRDL-TR–	**(Non-AEC)**	
543	16-13305	
551	16-12961	
VDIT–	**(Swedish)**	
54	16-13371	
WADD-TR–	**(Non-AEC)**	
60-22(Pt.I)	16-13707	OTS
60-22(Pt.II)	16-13708	OTS
60-22(Pt.IV)	16-13709	OTS
60-849	16-14360	$5.00(OTS)
WAPD–	**(Misc.)**	
252	16-13589	Dep.(mc); $0.50(OTS)
WAPD-AD–		
TH-544(Del.)	16-13185	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WAPD-R–		
(TH)-604	16-14319	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WAPD-T–		
1291	16-13222	p. 1-6 of "International Developments in Heat Transfer, Pt. I." New York, The American Society of Mechanical Engineers, 1961
WAPD-TM–	**(Misc.)**	
240	16-13504	Dep.; $2.25(OTS)
WT–	**(Misc.)**	
2*	16-12805	Dep.(mc); $4.60(fs), $1.49(mf) OTS
60(REF) Pt.I*	16-12806	Dep.(mc); $12.00(fs), $5.24(mf) OTS
60(REF) Pt.II*	16-12807	Dep.(mc); $9.60(fs), $3.65(mf) OTS
60(REF) Pt.III*	16-12808	Dep.(mc); $11.00(fs), $4.49(mf) OTS
91*	16-12809	Dep.(mc); $19.75(fs), $3.22(mf) OTS
716*	16-13710	Dep.(mc); $9.10(fs), $3.26(mf) OTS
772*	16-12810	Dep.(mc); $5.60(fs), $1.73(mf) OTS
776*	16-12811	Dep.(mc); $6.60(fs), $2.09(mf) OTS
781*	16-12812	Dep.(mc); $3.60(fs), $1.34(mf) OTS
1101*	16-12813	Dep.(mc); $4.60(fs), $1.61(mf) OTS
1117*	16-12814	Dep.(mc); $5.60(fs), $1.76(mf) OTS
1119*	16-13372	Dep.(mc); $10.50(fs), $4.13(mf) OTS
1127*	16-12815	Dep.(mc); $7.60(fs), $2.54(mf) OTS
1128*	16-12816	Dep.(mc); $6.60(fs), $2.18(mf) OTS
1419*	16-12817	Dep.(mc); $6.60(fs), $2.18(mf) OTS
1420*	16-12818	Dep.(mc); $10.50(fs), $4.37(mf) OTS
1423*	16-12819	Dep.(mc); $10.10(fs), $4.04(mf) OTS
XDC–		
59-11-94	16-14320	Dep.(mc); $3.60(fs), $1.25(mf) OTS
XDCL–		
59-9-725	16-14321	Dep.(mc); $8.60(fs), $3.17(mf) OTS
60-3-176	16-14322	Dep.(mc); $8.10(fs), $2.66(mf) OTS
YAEC–		
132	16-14323	Dep.; $1.50(OTS)
159	16-13552	Dep.; $2.75(OTS)